United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with the
Minnesota Agricultural
Experiment Station

Soil Survey of Mower County, Minnesota

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How To Use This Soil Survey

General Soil Map

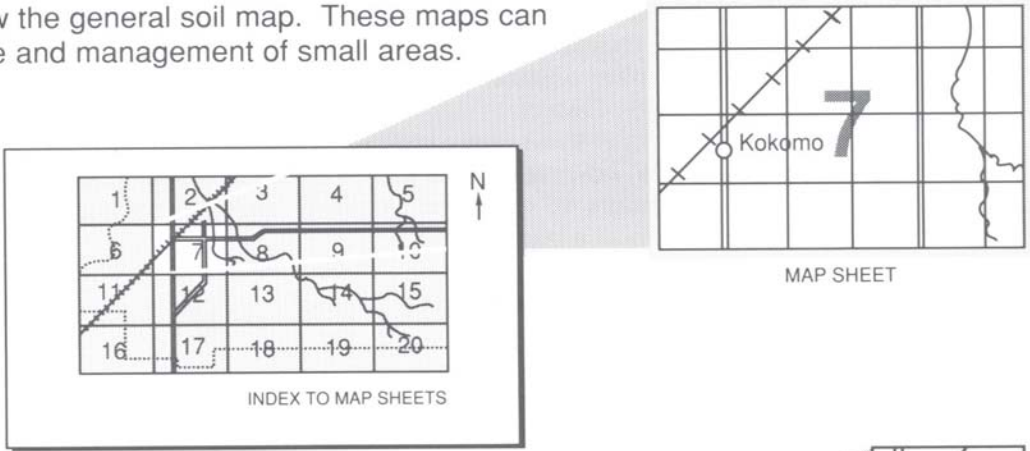
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

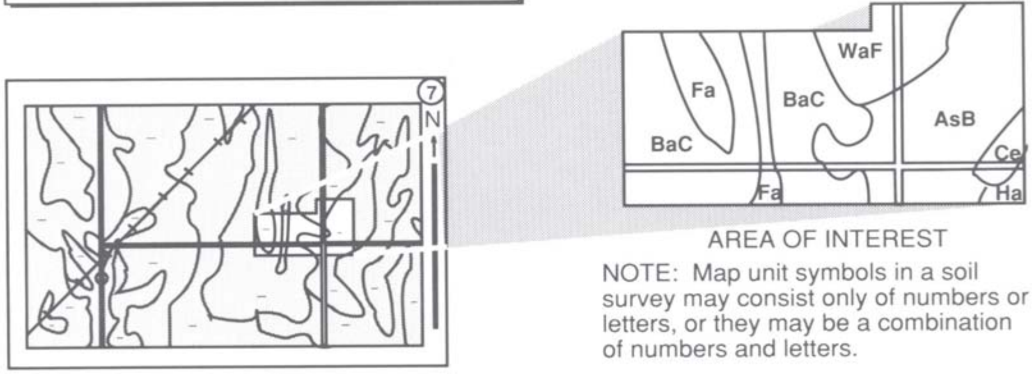
To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



INDEX TO MAP SHEETS

MAP SHEET

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET

AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, handicap, or age.

Major fieldwork for this soil survey was completed in 1984. Soil names and descriptions were approved in 1986. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1984. This survey was made cooperatively by the Soil Conservation Service and the Minnesota Agricultural Experiment Station, in cooperation with the Extension Service, the Minnesota Soil and Water Conservation Board, and the Mower County Soil and Water Conservation District. Mower County and the Legislative Commission for Minnesota Resources provided partial funding for the survey. The survey is part of the technical assistance furnished to the Mower County Soil and Water Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: A wooded pasture in an area of Kalmarville loam, frequently flooded.

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Foreword

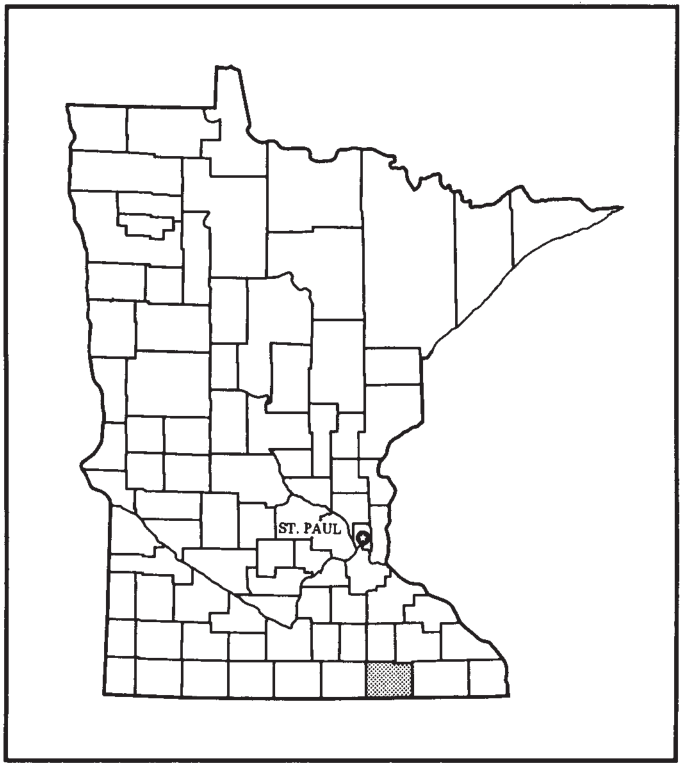
This soil survey contains information that can be used in land-planning programs in Mower County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Gary R. Nordstrom
State Conservationist
Soil Conservation Service



Location of Mower County in Minnesota.

Soil Survey of
Mower County, Minnesota

By Carroll R. Carlson, Soil Conservation Service

Fieldwork by Carroll R. Carlson, Joseph F. Cummins, Gerald W. McCormick, and
George Poch, Soil Conservation Service, and Stephan E. Lawler and Fred Renner,
Minnesota Agricultural Experiment Station

United States Department of Agriculture, Soil Conservation Service,
in cooperation with the
Minnesota Agricultural Experiment Station

Mower County is in the southeastern part of Minnesota (see facing page). The county has a total area of 449,920 acres. Austin, the county seat, had a population of 23,020 in 1980.

Farming is the main industry in the county, followed by meat packing and processing. Corn and soybeans are the main crops. Dairy products and livestock are other sources of income for some farmers.

Most of the soils in Mower County are deep and loamy and have restricted drainage. Many soils formed in silty sediments overlying glacial till. Some other soils formed in sandy glacial outwash, recent alluvium, or thin loamy sediments overlying weathered limestone bedrock.

This survey provides updated and additional information to a survey of Mower County published in 1955 *(8)* and provides maps that show the soils in greater detail.

Physiography, Relief, and Drainage

Mower County is generally nearly level to gently sloping. Some areas in the extreme western and eastern parts of the county are rolling or sloping, but few areas have slopes of more than 6 percent. Elevation ranges from about 1,440 feet above sea level along drainage divides in the central part of the county to about 1,150 feet above sea level along the Cedar River in the southwest part of the county. The western and central parts of the county are drained by the Cedar River. The north and south branches of the Root River, the Upper Iowa River, and the Little Cedar River drain the eastern parts of the county. There are no natural lakes in Mower County.

Climate

Prepared by the National Climatic Data Center, Asheville, North Carolina.

Table 1 provides data on temperature and precipitation for the survey area as recorded at Grand Meadow in the period 1951-80. Table 2 shows the probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on the length of the growing season.

In winter the average temperature is 15° F, and the average daily minimum temperature is 6°. The lowest temperature on record, which occurred at Grand Meadow on January 30, 1951, is -34°. In summer the average temperature is 68°, and the average daily maximum temperature is 79°. The highest recorded temperature, which occurred at Grand Meadow on August 22, 1955, is 100°.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50° F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 31.6 inches. Of this, 23 inches, or 70 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 18 inches. The heaviest 1-day rainfall during the period of record was 5.15 inches at Grand Meadow on August 30, 1962. Thunderstorms occur on about 42 days each year, and most occur in summer.

Average seasonal snowfall is 52 inches. The greatest snow depth at any one time during the period of record was 38 inches. On an average of 35 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 65 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent of the time in summer and 40 percent of the time in winter. The prevailing wind is from the south. Average windspeed is highest, 14 miles per hour, in spring.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material has few or no roots or other living organisms and has been changed very little by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

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General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The soils shown on some areas of the map do not match those shown on the maps of adjacent counties. These differences exist because of changes in the ways that soils are identified and mapped and differences in the extent of the soils in the adjoining units. Most of the differing areas are of minor extent and do not affect the accuracy or use of the map.

Soil Descriptions

1. Marshan-Waukee-Hayfield Association

Nearly level and gently sloping, poorly drained to well drained, loamy soils on outwash plains and stream terraces

This association has very little relief, but short slopes are in a few places. The areas along larger rivers are broad and uniform. Small streams commonly dissect the outwash plains. Slopes range from 0 to 6 percent.

This association makes up about 12 percent of the county. The association is about 30 percent Marshan soils, 25 percent Waukee soils, 20 percent Hayfield soils, and 25 percent soils of minor extent (fig. 1).

The Marshan soils are nearly level and poorly drained and are on low areas. Typically, the surface layer is black, friable clay loam about 10 inches thick. The subsurface layer is very dark gray, friable clay loam about 4 inches thick. The subsoil is about 15 inches thick. It is dark gray and gray, mottled, friable clay loam in the upper part and dark gray, mottled, friable sandy loam in the lower part. The underlying material to a depth of about 60 inches is grayish brown and yellowish brown, mottled loose coarse sand and gravelly coarse sand.

The Waukee soils are nearly level and gently sloping, are well drained, and are on higher areas. Typically, the surface layer is very dark brown, friable loam about 9 inches thick. The subsurface layer is very dark brown, friable loam about 7 inches thick. The subsoil is about 16 inches thick. The upper part is dark brown, friable loam and the lower part is brown loose loamy sand. The underlying material to a depth of about 60 inches is brown and yellowish brown gravelly sand and gravelly loamy coarse sand.

The Hayfield soils are nearly level and gently sloping, are moderately well drained and somewhat poorly drained, and are in intermediate areas. Typically, the surface layer is very dark gray, friable loam about 8 inches thick. The subsurface layer is dark grayish brown, mottled, friable loam about 5 inches thick. The subsoil is brown, mottled, friable loam about 16 inches thick. The underlying material to a depth of about 60 inches is yellowish brown, mottled loose coarse sand.

Of minor extent are poorly drained Mayer soils, very poorly drained Shandep soils, somewhat poorly drained Cylinder soils, and well drained Dowagiac and Fairhaven soils. The Mayer and Shandep soils are in depressions and drainageways. The Cylinder soils are on intermediate levels of outwash plains and stream terraces. The Dowagiac and Fairhaven soils are on higher levels and gently sloping parts of outwash plains and stream terraces.

Most areas of this association are used for corn, soybeans, wheat, or oats. A few areas are used for

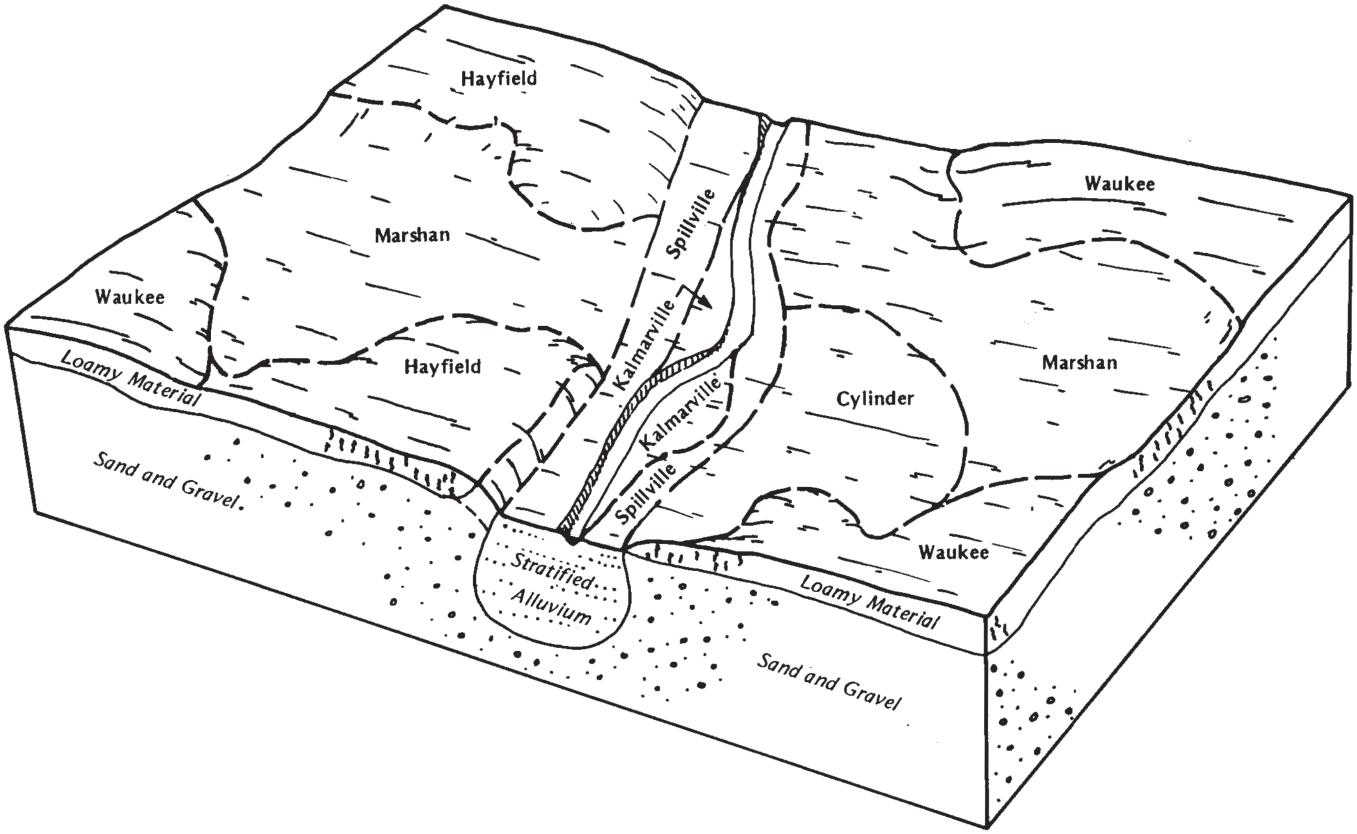

Figure 1.—Typical pattern of soils and parent material in the Marshan-Waukee-Hayfield association.

pasture. The wetness of the Marshan soils limits their suitability for farming unless they are drained. Droughtiness limits crop growth on the Waukee and Hayfield soils during dry periods.

The major soils in this association are well suited to poorly suited to building site development and are poorly suited to septic tank absorption fields.

2. Rossfield-Taopi-Faxon Variant Association

Nearly level and gently sloping, well drained and poorly drained, silty soils on uplands

This association is on bedrock-controlled uplands. Most areas are on nearly level uplands, but some are on gently sloping sides of valleys. Relief ranges from less than 20 feet in nearly level areas to about 75 feet in some valleys. Slopes are long and uniform, and most areas have a well formed dendritic drainage pattern. Slopes range from 0 to 6 percent.

This association makes up about 2 percent of the county. The association is about 40 percent Rossfield soils, 35 percent Taopi soils, 10 percent Faxon Variant soils, and 15 percent soils of minor extent.

The Rossfield soils are nearly level and gently sloping, are well drained, and are on low ridges. Typically, the surface layer is very dark brown, friable silt loam about 8 inches thick. The subsurface layer is very dark brown, friable silt loam about 7 inches thick. The subsoil is about 14 inches thick. The upper part is brown, friable loam, and the lower part is yellowish brown, friable loam. The underlying material to a depth of about 60 inches is brownish yellow, friable channery loam and channery sandy loam that is 20 to 30 percent soft weathered limestone channers.

The Taopi soils are nearly level and gently sloping, are well drained, and are on low rises and side slopes. Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 24 inches thick. The upper part is dark brown and yellowish brown, friable loam; the middle part is yellowish brown, friable clay loam; and the lower part is very dark grayish brown, very firm clay. The underlying material to a depth of about 60 inches is light gray, very friable cobbly silt loam that is 25 to 30 percent hard weathered limestone cobbles.

The Faxon Variant soils are nearly level and poorly drained and are in drainageways. Typically, the surface layer is black, friable silty clay loam about 10 inches thick. The subsurface layer is very dark gray, friable silty clay loam about 4 inches thick. The subsoil is about 23 inches thick. The upper part is dark grayish brown, friable silty clay loam; the middle part is olive gray, mottled, friable silt loam; and the lower part is grayish brown, mottled, friable clay loam. The underlying material to a depth of about 60 inches is yellowish brown, friable channery silt loam that is about 20 percent soft weathered limestone channers.

Of minor extent are well drained Atkinson, Ostrander, and Waucoma soils, moderately well drained Spillville soils, and somewhat poorly drained Floyd soils. The Atkinson and Waucoma soils are on low ridges and valley side slopes. The Spillville soils are on flood plains. The Floyd and Ostrander soils are on nearly level and gently sloping till plains.

Most areas of this association are used for corn, soybeans, wheat, or oats. A few areas are used for pasture. Soil erosion and droughtiness are major management concerns on the gently sloping Rossfield and Taopi soils. Drainage is needed on the Faxon Variant soils to improve crop growth. The Rossfield and Taopi soils are well suited to building site development and have fair suitability for septic tank absorption fields. The Faxon Variant soils are poorly suited to building site development and septic tank absorption fields.

3. Udolpho-Schley-Clyde Association

Nearly level, somewhat poorly drained and poorly drained, silty soils on outwash plains, stream terraces, and till plains

This association is on till plains and uplands. The landscape consists of nearly level flats, low swells, shallow swales, and drainageways. Local relief is about 10 feet. A poorly formed, somewhat irregular dendritic drainage system dissects the association.

This association makes up about 14 percent of the county. The association consists of about 35 percent Udolpho soils, 30 percent Schley soils, 10 percent Clyde soils, and 25 percent soils of minor extent.

The Udolpho soils are poorly drained and are on low ridges and swells and in drainageways on outwash plains and stream terraces. Typically, the surface layer is very dark grayish brown, very friable silt loam about 9 inches thick. The subsurface layer is grayish brown, very friable silt loam about 5 inches thick. The subsoil is about 13 inches thick. The upper part is grayish brown, mottled, friable loam, and the lower part is grayish brown, mottled, very friable loam. The underlying material to a depth of about 60 inches is grayish brown, mottled loose gravelly coarse sand.

The Schley soils are somewhat poorly drained and are on low ridges and swells and in shallow depressions on till plains. Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. The subsurface layer is grayish brown, mottled, friable silt loam about 5 inches thick. The subsoil is about 27 inches thick. The upper part is grayish brown, mottled, friable silt loam; the middle part is brown, mottled, friable sandy loam; and the lower part is strong brown, mottled, friable sandy clay loam. The underlying material to a depth of about 60 inches is brown, mottled, firm sandy clay loam.

The Clyde soils are poorly drained and are in drainageways and shallow depressions on till plains. Typically, the surface layer is black, friable silty clay loam about 9 inches thick. The subsurface layer is about 13 inches thick. It is black and very dark gray, friable silty clay loam. The subsoil is about 28 inches thick. It is grayish brown, mottled, friable loam in the upper part and olive gray, yellowish brown, and olive, mottled sandy loam, sandy clay loam, and loam in the lower part. The underlying material to a depth of about 60 inches is olive, mottled, firm loam.

Of minor extent are somewhat poorly drained Skyberg soils, well drained Dowagiac soils, excessively drained Lilah soils, and poorly drained Faxon Variant soils. The Skyberg soils are on low ridges. The Dowagiac and Lilah soils are on low hills. The Faxon Variant soils are in drainageways.

Most areas of this association are used for corn and soybeans. A few areas are used for pasture. Drainage is the main management concern. The major soils in this association are poorly suited to building site development and septic tank absorption fields.

4. Sargeant-Brownsdale Association

Nearly level, somewhat poorly drained and poorly drained, silty soils on till plains

This association consists of low ridges separated by broad drainageways. The relief is low, generally about 30 feet. A well formed dendritic drainage system dissects the association.

This association makes up about 4 percent of the

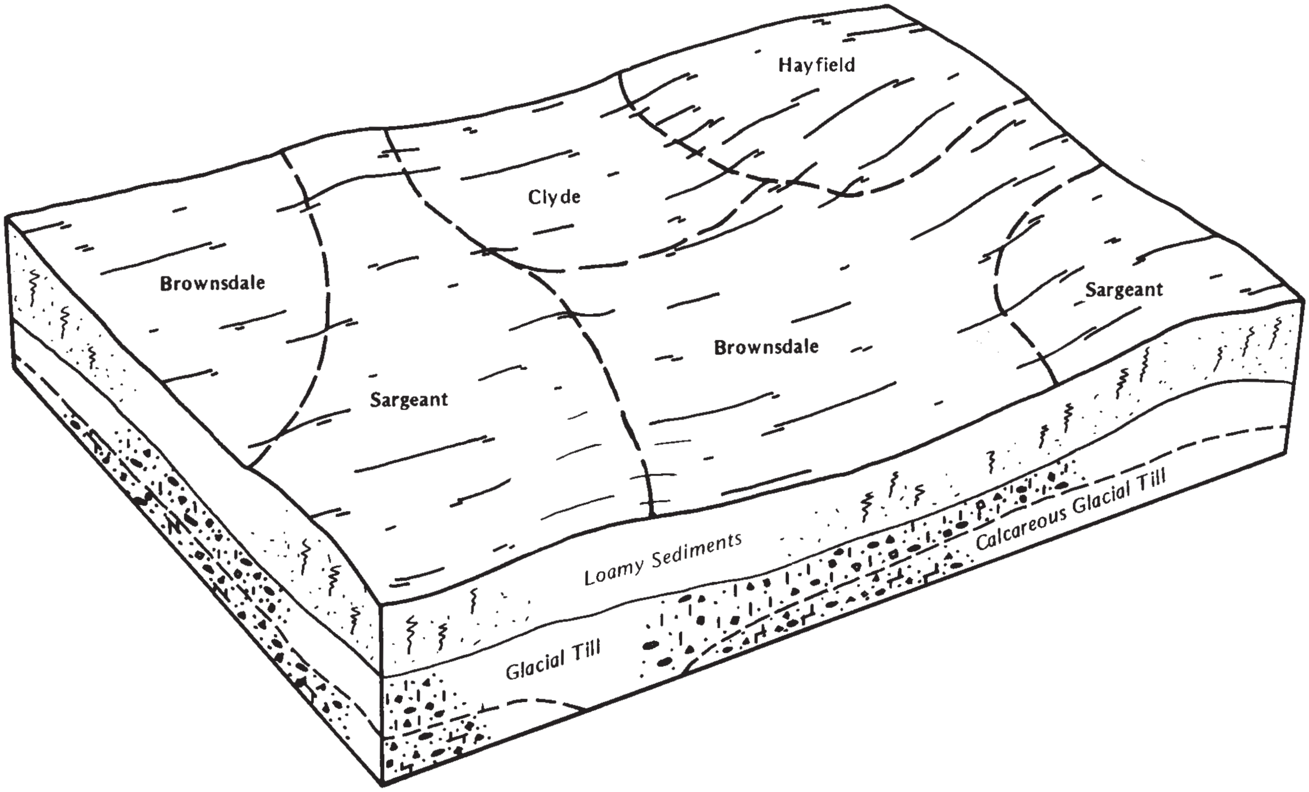

Figure 2.—Typical pattern of soils and parent material in the Sargeant-Brownsdale association.

county. The association consists of about 40 percent Sargeant soils, 25 percent Brownsdale soils, and 35 percent soils of minor extent (fig. 2).

The Sargeant soils are somewhat poorly drained and are on low ridges. Typically, the surface layer is dark gray, friable silt loam about 8 inches thick. The subsurface layer is light brownish gray and grayish brown, friable silt loam about 14 inches thick. It is mottled in the upper part. The next layer is yellowish brown, mottled, friable sandy loam about 6 inches thick. The subsoil is about 17 inches thick. It is yellowish brown, mottled, firm loam. The underlying material to a depth of about 60 inches is also yellowish brown, mottled, firm loam.

The Brownsdale soils are poorly drained and are in shallow depressions and drainageways. Typically, the surface layer is black, friable silt loam about 9 inches thick. The subsurface layer is dark gray, mottled, friable silt loam about 4 inches thick. The subsoil is about 31 inches thick. The upper part is gray and olive gray, mottled, friable silty clay loam, and the lower part is olive gray and gray, mottled, firm loam. The underlying material to a depth of about 60 inches is grayish brown, mottled, firm loam.

Of minor extent are poorly drained Clyde soils, moderately well drained to somewhat poorly drained Hayfield soils, poorly drained Udolpho soils, and somewhat poorly drained Skyberg soils. The Clyde soils are in draws and depressions. The Hayfield and Udolpho soils are on slight rises. The Skyberg soils are on low ridges.

Most areas of this association are used for corn and soybeans. Wetness is the main management concern. The major soils in this association are poorly suited to building site development and septic tank absorption fields.

5. Tripoli-Oran-Readlyn Association

Nearly level and gently sloping, poorly drained and somewhat poorly drained, silty soils on till plains

This association consists of low ridges separated by broad drainageways. Slopes are mostly long and

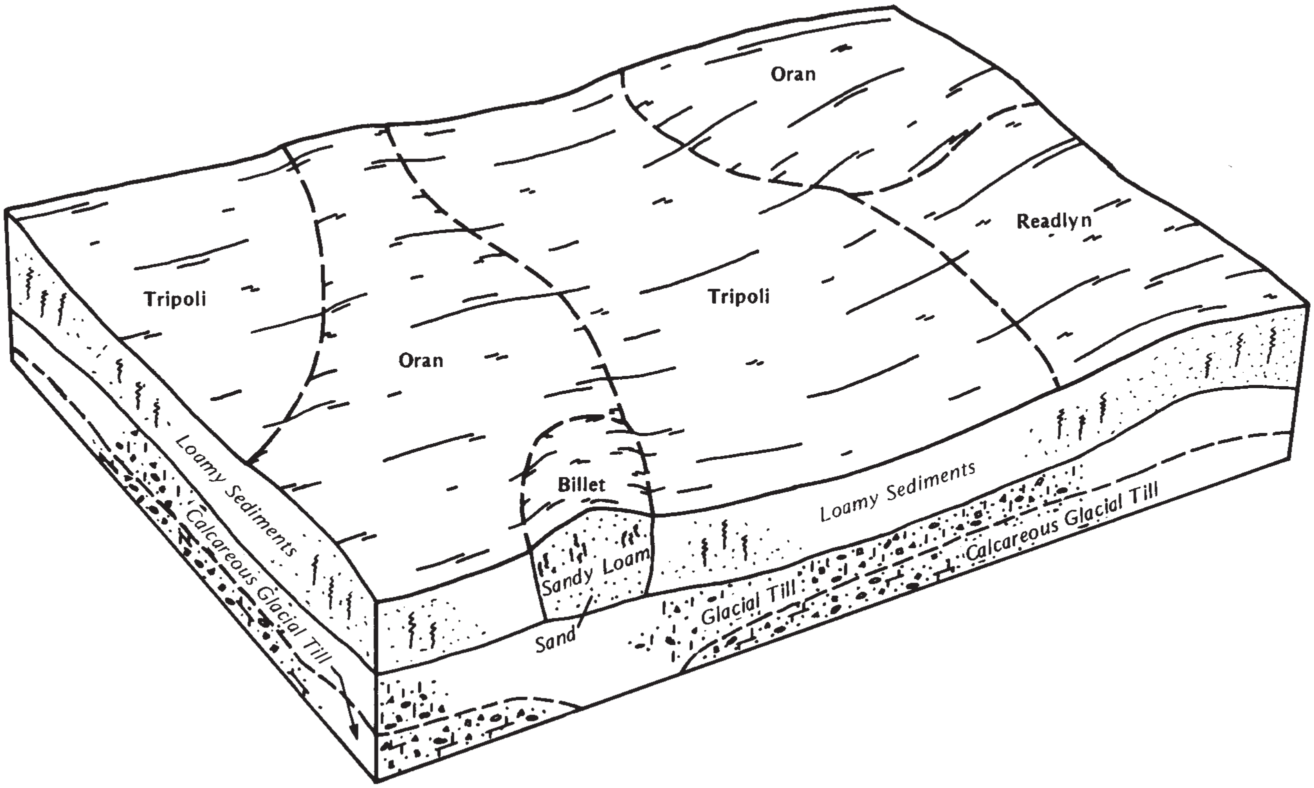

Figure 3.—Typical pattern of soils and parent material in the Tripoli-Oran-Readlyn association.

uniform. Relief ranges from 20 to 50 feet. A well formed dendritic drainage system dissects the association. This association makes up about 55 percent of the county. The association consists of about 35 percent Tripoli soils, 25 percent Oran soils, 15 percent Readlyn soils, and 25 percent soils of minor extent (fig. 3).

The Tripoli soils are nearly level and poorly drained and are in drainageways and shallow depressions. Typically, the surface layer is black, friable silty clay loam about 10 inches thick. The subsurface layer is black, friable silty clay loam about 6 inches thick. The subsoil is about 31 inches thick. The upper part is olive gray, mottled, friable silty clay loam and loam, and the lower part is olive gray and olive brown, mottled, firm loam. The underlying material to a depth of about 60 inches is olive brown, mottled, firm loam.

The Oran soils are nearly level to gently sloping, are somewhat poorly drained, and are on low ridges. Typically, the surface layer is very dark gray, friable silt loam about 8 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is about 34 inches thick. The upper part is dark grayish brown, friable silt loam; the middle part is grayish brown, mottled, friable loam; and the lower part is dark yellowish brown, mottled, friable to firm loam. The underlying material to a depth of about 60 inches is yellowish brown, mottled loam.

The Readlyn soils are nearly level and somewhat poorly drained and are on low ridges. Typically, the surface layer is black, friable silt loam about 8 inches thick. The subsurface layer is black and very dark grayish brown, friable silt loam about 9 inches thick. The subsoil is about 30 inches thick. It is dark brown, friable silty loam in the upper part; dark yellowish brown, mottled, firm loam in the middle part; and yellowish brown, mottled, firm loam in the lower part. The underlying material to a depth of about 60 inches is yellowish brown, mottled, firm, calcareous loam.

Of minor extent are somewhat poorly drained Skyberg soils, well drained Ostrander soils, moderately well drained to somewhat poorly drained Hayfield soils, and poorly drained Clyde soils. The Skyberg and

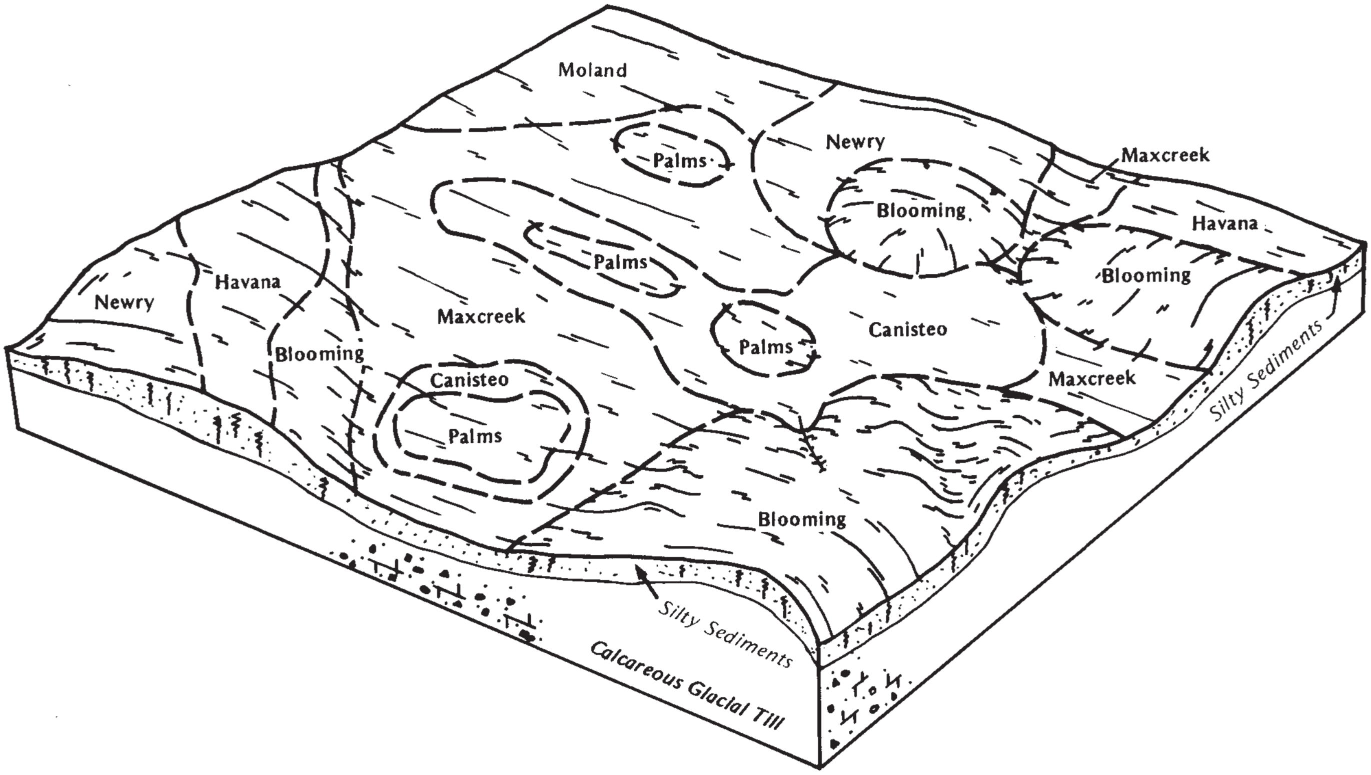

Figure 4.—Typical pattern of soils and parent material in the Blooming-Maxcreek-Havana association.

Ostrander soils are on low rises. The Hayfield soils are on foot slopes along major drainageways. The Clyde soils are in broad drainageways.

Most areas of this association are used for corn and soybeans. Drainage is needed. Erosion control is the main management concern on the Oran soils.

The Tripoli soils are poorly suited to building site development and septic tank absorption fields. The Oran and Readlyn soils have fair suitability for building site development and septic tank absorption fields.

6. Clyde-Floyd-Racine Association

Nearly level to sloping, poorly drained, somewhat poorly drained, and well drained, silty soils on till plains

This association consists of low ridges separated by broad drainageways. The ridges are slightly lower in elevation than the adjoining areas of the Tripoli-Oran-Readlyn association. Relief ranges from 20 feet to about 40 feet. A well formed dendritic drainage system dissects the association.

This association makes up about 9 percent of the county. The association consists of about 35 percent Clyde soils, 25 percent Floyd soils, 15 percent Racine soils, and 25 percent soils of minor extent.

The Clyde soils are nearly level and poorly drained and are in drainageways and shallow depressions. Typically, the surface layer is black, friable silty clay loam about 9 inches thick. The subsurface layer is about 13 inches thick. It is black and very dark gray, friable silty clay loam. The subsoil is about 28 inches thick. It is grayish brown, mottled, friable loam in the upper part and olive gray, yellowish brown, and olive, mottled sandy loam, sandy clay loam, and loam in the lower part. The underlying material to a depth of about 60 inches is olive, mottled, firm loam.

The Racine soils are nearly level to sloping, are well drained, and are on low ridges and back slopes of moraines. Typically, the surface layer is very dark brown, friable silt loam about 8 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 5 inches thick. The subsoil is about 32 inches thick. It is dark brown, friable silt loam in the upper part and yellowish brown, friable and firm loam in the lower part. The underlying material to a depth of about 60 inches is yellowish brown, friable loam.

The Floyd soils are gently sloping to nearly level, are somewhat poorly drained, and are on low ridges. Typically, the surface layer is very dark brown, friable silt loam about 10 inches thick. The subsurface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 32 inches thick. The upper part is dark grayish brown, mottled, friable sandy clay loam, and the lower part is dark grayish brown, mottled, firm loam. The underlying material to a depth of about 60 inches is olive brown, mottled, firm loam.

Of minor extent are excessively drained Lilah soils, well drained Dowagiac soils, somewhat poorly drained Readlyn soils, and poorly drained Clyde and Tripoli soils. The Lilah, Dowagiac, and Readlyn soils are on low rises. The Clyde and Tripoli soils are in drainageways and depressions.

Most areas of this association are used for corn and soybeans. A few areas are used for pasture. The main management concerns are erosion on the Racine and Ostrander soils and drainage on the Floyd soils.

The Racine and Ostrander soils are well suited and the Floyd soils have fair suitability for building site development and septic tank absorption fields.

7. Blooming-Maxcreek-Havana Association

Nearly level to moderately steep, well drained, poorly drained, and very poorly drained, silty soils on moraines

This association consists of irregularly sloping areas interspersed with nearly level areas. Slopes are mostly short. The natural drainage system is poorly developed and has many closed depressions.

This association makes up about 4 percent of the county. The association consists of about 40 percent Blooming soils, 20 percent Maxcreek soils, 15 percent Havana soils, and 25 percent soils of minor extent (fig. 4).

The Blooming soils are gently sloping to sloping, are well drained, and are on ridges and hills. Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 37 inches thick. The upper part is dark brown, friable silty clay loam and silt loam. The lower part is yellowish brown and light olive brown, friable loam. The underlying material to a depth of about 60 inches is light olive brown, friable, calcareous loam.

The Maxcreek soils are nearly level, are poorly drained and very poorly drained, and are in shallow depressions and drainageways. Typically, the surface layer is black, friable silty clay loam about 10 inches thick. The subsurface layer is very dark gray, friable silty clay loam about 8 inches thick. The subsoil is about 17 inches thick. The upper part is dark gray, mottled, friable silt loam, and the lower part is olive gray, mottled, friable loam. The underlying material to a depth of about 60 inches is olive gray, mottled, friable, calcareous loam.

The Havana soils are nearly level and poorly drained and are in broad, shallow depressions. Typically, the surface layer is very dark brown, friable silt loam about 8 inches thick. The subsurface layer is dark gray, friable silt loam about 3 inches thick. The subsoil is about 29 inches thick. The upper part is grayish brown, mottled, friable silt loam and silty clay loam, and the lower part is grayish brown, mottled, friable loam. The underlying material to a depth of about 60 inches is light olive brown, mottled, friable loam.

Of minor extent are moderately well drained Newry soils, well drained Moland soils, poorly drained Canisteo and Marshan soils, and very poorly drained Palms soils. The Newry and Moland soils are on low rises. The Canisteo and Marshan soils are in shallow depressions and drainageways. The Palms soils are in depressions.

Most areas of this association are used for corn and soybeans. Some areas are used for hay, pasture, or woodland. Controlling erosion is the main management concern on the Blooming soils, and drainage is needed on the Maxcreek and Havana soils.

The Blooming soils are well suited or have fair suitability for building site development or septic tank absorption fields. The Maxcreek and Havana soils are poorly suited or unsuited to these uses.

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Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Racine silt loam, 2 to 6 percent slopes, is one of several phases in the Racine series.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, quarry, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

2A—Ostrander loam, 0 to 2 percent slopes. This soil is nearly level and well drained. It is on slightly convex to plane ridgetops on till plains. The areas are irregular in shape and range from 2 acres to about 25 acres.

Typically, the surface layer is very dark brown and dark brown, friable loam about 19 inches thick. The subsoil is about 38 inches thick. The upper part of the subsoil is brown and dark yellowish brown, friable silt loam and loam. The lower part is dark yellowish brown, friable sandy clay loam and thin layers of sandy loam. The underlying material to a depth of about 60 inches is yellowish brown, firm loam. In places the firm loam is nearer to the surface and mottles are in the subsoil.

Included with this soil in mapping are small areas of the somewhat poorly drained Floyd soils and the poorly drained Clyde soils in drainageways. Included soils make up 2 to 10 percent of this map unit.

Permeability in this Ostrander soil is moderate. Surface runoff is slow. Available water capacity is high. Organic matter content is moderate, and natural fertility is high.

Most areas of this soil are used for and well suited to row crops. The common crops are corn and soybeans. After heavy rains a crust commonly forms on the surface and puddles are common. Reducing the number of tillage operations prevents crusting and reduces water erosion.

The suitability of this soil for trees and shrubs in windbreaks is good. Completion of site preparation in the fall helps to reduce plant competition. Tilling for weed control in early spring sometimes causes clodding. Herbicides and shallow cultivation help to control weeds and grasses in newly established windbreaks.

The land capability classification is I.

2B—Ostrander loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on side slopes and ridgetops on till plains. The areas are irregular in shape and range from 3 acres to about 50 acres.

Typically, the surface layer is very dark brown, friable loam about 8 inches thick. The subsurface layer is very dark brown and dark brown, friable loam about 8 inches thick. The subsoil is about 34 inches thick. The upper part of the subsoil is brown, friable silt loam; the middle part is dark yellowish brown, friable loam and sandy clay loam; and the lower part is mottled, yellowish brown, friable sandy clay loam. The underlying material to a depth of about 60 inches is yellowish brown loam. In places up to 20 inches of the subsoil is loamy sand or the surface layer is thinner.

Included with this soil in mapping are small areas of the somewhat poorly drained Floyd soils and the poorly drained Clyde soils in drainageways. Included soils make up 2 to 10 percent of this map unit.

Permeability in this Ostrander soil is moderate. Surface runoff is medium. Available water capacity is high. Organic matter content is moderate, and natural fertility is high.

Most areas of this soil are in cropland and are well suited to this use. Corn and soybeans are the common crops. Erosion is the main management concern. Crop residue in and on the soil, contour farming, and terracing help to control erosion. The crop residue also helps to prevent puddling on and crusting of the surface layer after heavy rains.

The suitability of this soil for trees and shrubs in windbreaks is good. Completion of site preparation in the fall before planting helps to reduce plant competition. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIe.

23—Skyberg silt loam. This soil is nearly level and somewhat poorly drained. It is in shallow depressions and on slight rises on till plains. The areas are irregular in shape and range from 3 acres to about 100 acres.

Typically, the surface layer is black, friable silt loam about 8 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 4 inches thick. The subsoil is about 38 inches thick. The upper part of the subsoil is grayish brown, mottled, friable silty clay loam. The lower part is yellowish brown, mottled, firm loam. The underlying material to a depth of about 60 inches is yellowish brown, mottled, firm, calcareous loam.

Included with this soil in mapping are small areas of the moderately well drained Hayfield and Kasson soils on slight rises. Also included are areas of very poorly drained Brownsville soils in small depressions. Included soils make up 5 to 15 percent of the map unit.

Permeability in this Skyberg soil is moderate in the upper part and moderately slow in the lower part. Surface runoff is slow. Available water capacity is high. The organic matter content is moderate. Natural fertility is medium. The seasonal high water table is at a depth of 1 to 3 feet.

Most areas of this soil are used for row crops and have fair suitability for this use. Corn and soybeans are the common crops. Tile drains across the slope improve workability of the soil and improve drying and warming of the soil in the spring. Crusting of and puddling on the surface layer are common after hard rains. Conservation tillage and using crop residues help reduce crusting. Fall tillage improves spring seedbeds because frost action breaks up the clods.

The suitability of this soil for trees and shrubs, mainly wetness-tolerant species, in windbreaks is fair to poor. Drainage lowers the seasonal high water table and provides a deeper root zone for trees. Completion of site preparation is needed the fall before planting because in many years this soil is too wet to till in early spring without causing clods. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIIw.

24B—Kasson silt loam, 1 to 4 percent slopes. This soil is gently sloping and moderately well drained. It is on side slopes and knolls on till plains. The areas are irregular in shape and range from 3 acres to about 50 acres.

Typically, the surface layer is very dark gray, friable silt loam about 7 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 4 inches thick. The subsoil is about 42 inches thick. It is dark brown, friable silty clay loam in the upper part; dark brown, mottled, friable loam in the next part; brown, mottled, firm loam in the next part; and dark yellowish brown, firm loam in the lower part. The underlying material to a depth of about 60 inches is yellowish brown, firm loam. In places the subsoil contains stratified layers up to 8 inches thick of loamy sand, sand, and sandy loam with some gravel. Also in a few places the subsoil and underlying material are clay loam or clay.

Included with this soil in mapping are small areas of the poorly drained Tripoli soils in shallow depressions and drainageways. Included soils make up 10 to 15 percent of the map unit.

Permeability in this Kasson soil is moderately slow. Surface runoff is medium. Available water capacity is high. Organic matter content is moderate. Natural fertility is medium. The seasonal high water table is at a depth of 2 to 3 feet.

Most areas of this soil are used for and well suited to row crops. Corn and soybeans are the common crops. Minimum tillage and using crop residue help to reduce erosion and prevent puddling and crusting of the soil after heavy rains. Contour farming helps to control erosion on some of the more sloping areas. Fall tillage improves spring seedbeds because frost action breaks up clods.

The suitability of this soil for trees and shrubs in windbreaks is good. Completion of site preparation the fall before planting helps to control weeds and improve the seedbed for tillage in early spring without causing clods. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIs.

27A—Dickinson fine sandy loam, 0 to 2 percent slopes. This soil is nearly level and well drained. It is on plane to slightly convex areas of outwash plains and stream terraces. The areas are irregular in shape and range from 5 to about 20 acres.

Typically, the surface layer is very dark brown, friable fine sandy loam about 12 inches thick. The subsurface is very dark gray, friable fine sandy loam about 5 inches thick. The subsoil is about 34 inches thick. The upper part of the subsoil is brown or dark brown, very friable fine sandy loam, loam, and sandy loam; the lower part is yellowish brown, very friable loamy sand. The underlying material to a depth of about 60 inches is yellowish brown loose sand. In places the underlying material is mottled and a water table is at a depth of about 3 feet.

Included with this soil in mapping are areas of the somewhat poorly drained Cylinder soils on slightly lower landscape positions. Also included are areas near major streams where bedrock is at a depth of 40 to 60 inches. Included soils make up 2 to 12 percent of the map unit.

Permeability in this Dickinson soil is moderately rapid in the upper part and rapid in the lower part. Surface runoff is medium. Available water capacity is low to moderate. Organic matter content is moderately low. Natural fertility is medium.

Most areas of this soil are used for and well suited to row crops. The common crops are corn, soybeans, wheat, and oats. Droughtiness and soil blowing are the main management concerns on this soil. Because of the hazard of late-season droughtiness, early-maturing crops such as small grains are better suited to this soil than are most other crops. Irrigation improves the suitability of crops. A conservation tillage system that uses crop residue in and on the soil and spring tillage conserve moisture and help reduce soil blowing.

The suitability of this soil for trees and shrubs in windbreaks is good, especially for drought-tolerant species. Completion of site preparation in the spring before planting helps to reduce erosion caused by wind. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIs.

27B—Dickinson fine sandy loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on convex ridgetops and side slopes of outwash plains and stream terraces. The areas of the unit are irregular in shape and range from 3 acres to about 50 acres.

Typically, the surface layer is very dark brown, friable fine sandy loam about 8 inches thick. The subsurface layer is very dark brown and very dark gray, very friable fine sandy loam about 8 inches thick. The subsoil is about 24 inches thick. The upper part of the subsoil is brown, very friable fine sandy loam; the middle part is yellowish brown, very friable fine sandy loam; and the lower part is yellowish brown, very friable loamy sand. The underlying material to a depth of about 60 inches is yellowish brown loose sand. In places loamy sand or sand is nearer to the surface or the underlying material is mottled and a water table is at a depth of about 3 feet.

Included with this soil in mapping are the somewhat poorly drained Cylinder soils on slightly lower landscape positions. Included soils make up 2 to 12 percent of the map unit.

Permeability in this Dickinson soil is moderately rapid in the upper part and rapid in the lower part. Surface runoff is medium. Available water capacity is moderately low to moderate. Organic matter content is low. Natural fertility is medium.

Most areas of this soil are used for and well suited to row crops. Corn, soybeans, wheat, and oats are the common crops. The hazard of erosion is the main management concern. A conservation tillage system that uses crop residue in and on the soil, a cover crop, and spring tillage help reduce runoff and soil blowing and conserve moisture. Because of the hazard of late-season droughtiness, early-maturing crops such as small grains are better suited to this soil than are most other crops. Irrigation improves the suitability for crops.

The suitability of this soil for trees and shrubs in windbreaks is good, especially for drought-tolerant species. Completion of site preparation in the spring before planting helps to reduce erosion caused by wind. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIe.

30B—Kenyon silt loam, 1 to 6 percent slopes. This soil is gently sloping and moderately well drained and well drained. It is on convex ridgetops and side slopes on till plains. The areas are irregular in shape and range from 2 acres to about 100 acres.

Typically, the surface layer is black, friable silt loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 32 inches thick. The upper part of the subsoil is dark brown, friable silt loam. The lower part is yellowish brown, firm loam. The underlying material to a depth of about 60 inches is yellowish brown, firm loam. In some areas the lower part of the subsoil and the underlying material are friable. In some places the surface layer is thinner and lighter colored or the subsoil is mottled.

Included with this soil in mapping are small areas of poorly drained Tripoli soils in drainageways. Included soils make up 2 to 10 percent of the unit.

Permeability in this Kenyon soil is moderate. Surface runoff is medium, and available water capacity is high. The content of organic matter is moderate, and natural fertility is high.

Most areas of this soil are used for and well suited to cultivated crops. Corn and soybeans are the common crops. The hazard of erosion is the main management concern. It can be controlled by a conservation tillage system that uses crop residue in and on the soils, contour farming, and terracing. Conservation tillage also reduces puddling and crusting of the surface after heavy rains. Tile drainage improves the suitability for crops and improves workability in some areas.

The suitability of this soil for trees and shrubs in windbreaks is good. Completion of site preparation the fall before planting helps to reduce plant competition and reduce formation of clods. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIe.

44—Ankeny fine sandy loam. This soil is nearly level and well drained. It is on low stream terraces mainly along the Red Cedar River. This soil is subject to occasional flooding. The areas are long and narrow and range from 5 to 50 acres.

The surface soil is very dark gray, very dark grayish brown, and black, very friable fine sandy loam about 30 inches thick. The subsoil is brown, very friable fine sandy loam about 24 inches thick. The underlying material to a depth of about 60 inches is brown, very friable fine sandy loam. In places the surface layer and subsoil contain more silt.

Included with this soil in mapping are small areas of the poorly drained Coland and the poorly drained and very poorly drained Kalmarville soils on similar landscape positions. Also included are the somewhat excessively drained Dickinson soils on slight rises above flood plains. Included soils make up 5 to 15 percent of the map unit.

Permeability in this Ankeny soil is moderately rapid. Surface runoff is slow, and available water capacity is high. The content of organic matter is moderate, and natural fertility is medium.

Most areas of this soil are used for and well suited to row crops. The common crops are corn and soybeans. Occasional flooding is a hazard to crops in some years. This soil usually warms quickly and is ready for early field work.

Some inaccessible or isolated areas of this soil are used as pasture, are idle, or are wooded. Many of the pastures are planted to bluegrass that receives little or no management other than periodic clipping. More forage can be obtained in these areas by using fertilizer, controlled grazing, and interseeded legumes such as ladino or birdsfoot trefoil that require little or no added fertilizer.

The native forest stands are mostly bottom-land timber species managed for firewood or lumber. The soil is suitable for plantings of walnut trees, ash, maple, oak, and hackberry.

The land capability classification is IIs.

79B—Billett fine sandy loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on convex side slopes and ridgetops and low knolls on stream terraces and outwash plains. The areas of this soil are irregular in shape and range from 2 acres to about 10 acres.

Typically, the surface layer is very dark grayish brown, very friable fine sandy loam about 7 inches thick. The subsurface layer is dark grayish brown, very friable sandy loam about 3 inches thick. The subsoil is about 26 inches thick and is brown, very friable sandy loam and loamy fine sand. The underlying material to a depth of about 60 inches is yellowish brown loose loamy fine sand and sand. In places the underlying material is mottled and a water table is at a depth of about 3 feet.

Included with this soil in mapping are small areas of poorly drained soils in depressions and drainageways. They make up about 5 to 15 percent of the unit.

Permeability in this Billett soil is moderately rapid in the upper part and rapid in the lower part. Surface runoff is medium, and available water capacity is moderate. The content of organic matter is moderately low, and natural fertility is medium.

Most areas of this soil are used for row crops and have fair suitability for that use. The common crops are corn, soybeans, oats, and wheat. Conservation tillage and contour farming reduce runoff and the hazard of erosion. Droughtiness causes crop damage in years with low rainfall, and irrigation improves the suitability for crops. Delaying tillage until spring helps reduce soil blowing.

The suitability of this soil for trees and shrubs in windbreaks is good, especially for drought-tolerant species. Completion of site preparation in the spring before planting helps to reduce erosion caused by wind. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIIs.

83—Maxcreek silty clay loam, swales. This soil is nearly level and very poorly drained. It is in shallow depressions and drainageways on moraines. Ponding is frequent for long periods. The areas vary in shape and range from 2 acres to about 15 acres.

Typically, the surface layer is black, friable silty clay loam about 10 inches thick. The subsurface layer is very dark gray, friable silty clay loam about 8 inches thick. The subsoil is about 17 inches thick. The upper part of the subsoil is dark gray, friable silt loam, and the lower part is olive gray, mottled, friable loam. The underlying material to a depth of about 60 inches is olive gray, mottled, friable, calcareous loam. In some areas this material is dense. A thin discontinuous coarse textured layer up to 5 inches thick commonly separates the upper and lower parts of the subsoil.

Included with this soil in mapping are small areas of soils with a clayey subsoil. They are in depressions. Also included are the very poorly drained Palms soils in small, shallow depressions. Included soils make up 2 to 15 percent of the unit.

Permeability in this Maxcreek soil is moderate. Surface runoff is slow to ponded. Available water capacity is high. Organic matter content and natural fertility also are high. The seasonal high water table ranges from the surface to a depth of 2 feet.

Most areas of this soil are used for cultivated crops and have fair suitability for this use. The common crops are corn, soybeans, oats, and wheat. Some areas are in pasture. Wetness is the main management concern. Tile drainage improves the suitability and workability of the soil and enables the soil to warm more quickly in the spring. Fall tillage improves spring seedbeds because frost action breaks up the clods.

The suitability of this soil for trees and shrubs in windbreaks is fair, especially for wetness-tolerant species. Drainage increases the rooting depth for trees. Completion of site preparation is needed the fall before planting because in many years this soil is too wet to till in early spring. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIIw.

88—Clyde silty clay loam. This soil is nearly level and poorly drained. It is in shallow depressions and drainageways on till plains. The areas vary in shape and range from 2 acres to about 80 acres.

Typically, the surface layer is black, friable silty clay loam about 9 inches thick. The subsurface layer is black and very dark gray, friable silty clay loam about 13 inches thick. The subsoil is about 28 inches thick. It is grayish brown, mottled, friable loam in the upper part and olive gray, yellowish brown, and olive, mottled sandy loam, sandy clay loam, and loam in the lower part. The underlying material to a depth of about 60 inches is olive, mottled, firm loam. In many places, especially along drainageways, the underlying material contains more clay.

Included with this soil in mapping are small areas of the very poorly drained Palms soils in small depressions and the very poorly drained Shandep soils in drainageways and shallow depressions. Included soils make up about 20 percent of the unit.

Permeability in this Clyde soil is moderate. Surface runoff is slow, and available water capacity is high. The content of organic matter is very high, and natural fertility is high. The seasonal high water table is at depths of 1.0 to 2.5 feet.

Most areas of this soil are used as cropland and are well suited to this use. The common crops are corn and soybeans. Wetness is the main management concern. Tile drainage improves suitability and workability of the soil, and enables the soil to warm more quickly in the spring. Fall tillage improves spring seedbeds because frost action breaks up the clods. Many of the areas that are in pasture or are idle do not have tile outlets. Grazing when the soil is wet makes the soil hummocky and lowers the quality of the pasture. The suitability for high-quality pastures is good if wetness-tolerant perennial grasses such as Garrison creeping foxtail and reed canarygrass are used and grazing is controlled when the soil is wet.

The suitability of this soil for trees and shrubs in windbreaks is fair, especially for wetness-tolerant species. Drainage increases the rooting depth for trees. Completion of site preparation is needed the fall before planting to reduce plant competition and because in many years this soil is too wet to till in early spring. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIw.

99A—Racine silt loam, 0 to 2 percent slopes. This soil is nearly level and well drained. It is on plane or slightly convex ridgetops on till plains. The areas are irregular in shape and range from 2 acres to about 100 acres.

Typically, the surface layer is very dark brown, friable silt loam about 8 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is about 34 inches thick. It is dark brown, friable silt loam in the upper part and yellowish brown, friable loam or sandy loam in the lower part. The underlying material to a depth of about 60 inches is yellowish brown, firm loam. In places stratified layers of loamy sand and sandy loam up to 18 inches thick are in the lower part of the subsoil or the subsoil is mottled.

Included with this soil in mapping are small areas of the poorly drained Clyde and Tripoli soils in drainageways. Also included are the somewhat poorly drained Skyberg soils in shallow depressions and drainageways. Included soils make up 2 to 10 percent of the map unit.

Permeability in this Racine soil is moderate. Surface runoff is medium. Available water capacity is high. The organic matter content is moderate. Natural fertility is high.

Most areas of this soil are used for row crops and are well suited to this use. Corn and soybeans are the common crops. Crusting of and puddling on the surface layer are common after hard rains. Conservation tillage and using crop residue help reduce crusting.

The suitability of this soil for trees and shrubs in windbreaks is good. Completion of site preparation is needed the fall before planting because in many years this soil is too wet to till in early spring without causing clods. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is I.

99B—Racine silt loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on convex ridgetops and side slopes on till plains. The areas are irregular in shape and range from 2 acres to about 100 acres.

Typically, the surface layer is very dark brown, friable silt loam about 8 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 5 inches thick. The subsoil is dark brown, friable silt loam in the upper part and yellowish brown, friable loam in the lower part. It is about 32 inches thick. The underlying material to a depth of about 60 inches is yellowish brown, firm loam. In places stratified layers of loamy sand and sandy loam up to 8 inches thick are in the lower part of the subsoil or the subsoil is mottled.

Included with this soil in mapping are small areas of the poorly drained Clyde and Tripoli soils in drainageways. Also included are the somewhat poorly drained Skyberg soils in shallow depressions and drainageways. Included soils make up 2 to 10 percent of the map unit.

Permeability in this Racine soil is moderate. Surface runoff is medium. Available water capacity is high. Organic matter content is moderate. Natural fertility is high.

Most areas of this soil are used for row crops and are well suited to this use. Corn and soybeans are the common crops. The hazard of erosion is the main management concern. Conservation tillage, contour farming, and using crop residue help control erosion. Crop residue and a crop cover help reduce puddling and crusting after heavy rains.

The suitability of this soil for trees and shrubs in windbreaks is good. Completion of site preparation is needed in the fall before planting to reduce plant competion and clod formation caused by tilling when the soil is too wet. Shallow cultivation, mulch, and herbicides help to control weeds and grasses in windbreaks.

The land capability classification is IIe.

99C—Racine silt loam, 6 to 12 percent slopes. This soil is sloping and well drained. It is on convex ridgetops and side slopes on till plains. The areas are long and narrow and range from 2 acres to about 15 acres.

Typically, the surface layer is very dark brown, friable silt loam about 6 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 3 inches thick. The subsoil is about 28 inches thick. It is dark brown, friable silt loam in the upper part and yellowish brown, firm loam in the lower part. The underlying material to a depth of about 60 inches is yellowish brown, firm loam. In places the upper part of the subsoil is mottled. In a few areas the soils have been eroded and have a thinner surface layer. In some other places slopes are greater than 12 percent.

Included with this soil in mapping are small areas of the poorly drained Clyde and Tripoli soils in drainageways. Included soils make up 2 to 10 percent of the map unit.

Permeability in this Racine soil is moderate. Surface runoff is medium to rapid. Available water capacity is high. Organic matter content is moderate. Natural fertility is high.

Most areas of this soil are used for cropland and have fair suitability for this use. The common crops are corn, soybeans, hay, oats, and wheat. Some areas are in pasture. The hazard of erosion is the main management concern. A conservation tillage system that leaves crop residue on the surface, contour farming, and maintaining a plant cover are practices that minimize erosion. Controlled grazing, fertilizing, and reseeding legumes such as ladino and birdsfoot trefoil help to improve pastures.

The suitability of this soil for trees and shrubs in windbreaks is good. Completion of site preparation the fall before planting helps to reduce plant competition. Shallow cultivation and herbicides help to control weeds and grasses in windbreaks.

The land capability classification is IIIe.

129—Cylinder loam. This soil is nearly level and somewhat poorly drained. It is on plane to slightly concave areas of glacial outwash plains and stream terraces. The areas are irregular in shape and range from 3 acres to about 80 acres.

Typically, the surface layer is very dark brown, friable loam about 11 inches thick. The subsurface layer is very dark brown, friable loam about 5 inches thick. The subsoil is about 15 inches thick. The upper part of the subsoil is dark grayish brown, friable loam, and the lower part is dark brown, mottled, friable loam and sandy loam. The underlying material to a depth of about 60 inches is grayish brown, loose, calcareous gravelly sand. In places the subsoil is grayish or the surface layer is thinner and lighter colored.

Included with this soil in mapping are small areas of the well drained Dickinson, Fairhaven, and Waukee soils on slightly higher rises and convex slopes and the poorly drained Marshan and very poorly drained Shandep soils in depressions and drainageways. Included soils make up 10 to 15 percent of the map unit.

Permeability in this Cylinder soil is moderate in the upper part and very rapid in the underlying material. Surface runoff is slow. Available water capacity is moderate. Organic matter content and natural fertility are high. The seasonal high water table is at a depth of 2 to 4 feet.

Most areas of this soil are used for row crops and small grains and are well suited to those uses. Droughtiness is the main management concern in the latter part of the growing season, and wetness is a concern in early spring. Droughtiness causes crop damage in years with low rainfall, and irrigation improves the suitability for crops. Tile drainage improves workability and enables the soil to warm up more quickly in the spring. Delaying tillage until spring, conservation tillage, and maintaining a plant cover help to reduce soil blowing.

The suitability of this soil for trees and shrubs in windbreaks is good, especially for drought-tolerant species. Drainage lowers the seasonal high water table and provides a deeper root zone for trees. Completion of site preparation before planting helps to reduce plant competition. Shallow cultivation and herbicides help to control weeds in windbreaks.

The land capability classification is IIs.

135—Donnan silt loam. This soil is nearly level and somewhat poorly drained or moderately well drained. It is on low ridges on till plains. The areas are irregular in shape and range from 3 acres to about 100 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. The subsurface layer is dark grayish brown, friable loam about 4 inches thick. The subsoil to a depth of about 60 inches is yellowish brown and brown, friable to firm loam and clay loam in the upper part; light olive brown, mottled, friable clay loam in the middle part; and gray and dark gray, mottled, very firm silty clay in the lower part. In places, the lower part of the subsoil is friable or firm loam or stratified layers of loamy sand and sandy loam as much as 18 inches thick are in the subsoil.

Included with this soil in mapping are small areas of the somewhat poorly drained Riceville soils and poorly drained Stateline and Tripoli soils in drainageways. Included soils make up 5 to 15 percent of the map unit.

Permeability in this Donnan soil is moderate in the upper part and very slow in the lower part. Surface runoff is medium. Available water capacity is high. The organic matter content is moderate. Natural fertility is medium. The seasonal high water table is at a depth of 2 to 3 feet.

Most areas of this soil are used for row crops and are well suited to this use. Corn, soybeans, and hay are the common crops. Tile drains, some of which must be closely spaced to overcome the permeability, improve drying and warming of the soil in the spring. Crusting of and puddling on the surface layer are common after hard rains. Using crop residue reduces crusting. Fall tillage improves spring seedbeds because frost action breaks up the clods.

The suitability of this soil for trees and shrubs, mainly wetness-tolerant species, in windbreaks is fair to poor. Drainage lowers the seasonal high water table and provides a deeper root zone for trees. Completion of site preparation is needed the fall before planting because in many years this soil is too wet to till in early spring without causing clods. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIw.

156A—Fairhaven silt loam, 0 to 2 percent slopes. This soil is nearly level and well drained. It is on plane to slightly convex areas of glacial outwash plains and stream terraces. The areas are irregular in shape and range from 10 to about 200 acres.

Typically, the surface layer is very dark brown, friable silt loam about 9 inches thick. The subsurface layer is very dark brown, friable silt loam about 6 inches thick. The subsoil is about 20 inches thick. The upper part of the subsoil is dark brown, friable silt loam or loam, and the lower part is dark brown, loose loamy sand or gravelly coarse sand. The underlying material to a depth of about 60 inches is brown, loose gravelly coarse sand. In places the surface layer is thinner or lighter colored and is loam or sandy loam. In places the underlying material is sandy.

Included with this soil in mapping are small areas of the poorly drained Marshan soils and very poorly drained Shandep soils in drainageways and depressions. Also included are the somewhat poorly drained Udolpho and Cylinder soils in shallow concave areas. Included soils make up 5 to 15 percent of the map unit.

Permeability in this Fairhaven soil is moderate in the upper part and rapid in the underlying material. Surface runoff is slow. Available water capacity is moderate. Organic matter content is moderate to high. Natural fertility is medium.

Most areas of this soil are used for and well suited to row crops, mainly early-season varieties. Corn, soybeans, oats, and wheat are the common crops. Droughtiness, especially late in the season, causes crop damage in years with low rainfall, and irrigation improves the suitability for crops. Delayed tillage until spring and conservation tillage help to reduce soil blowing.

The suitability of this soil for trees and shrubs, mainly drought-tolerant species, in windbreaks is good. Completion of site preparation in the spring before planting helps to reduce erosion caused by wind. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIs.

156B—Fairhaven silt loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on convex side slopes and on gentle rises on glacial outwash plains and stream terraces. The areas are irregular in shape and range from 5 to about 80 acres.

Typically, the surface layer is very dark brown, friable silt loam about 12 inches thick. The subsoil is about 16 inches thick. The upper part of the subsoil is dark brown, friable silt loam or loam, and the lower part is dark brown, friable to loose loamy sand. The underlying material to a depth of about 60 inches is brown, loose gravelly coarse sand. In places the surface layer is thinner or lighter colored and is loam or sandy loam.

Included with this soil in mapping are small areas of the poorly drained Marshan soils and very poorly drained Shandep soils in drainageways and depressions. Also included are the somewhat poorly drained Udolpho soils in shallow, slightly concave areas. Included soils make up 5 to 15 percent of the map unit.

Permeability in this Fairhaven soil is moderate in the upper part and rapid in the underlying material. Surface runoff is medium, and available water capacity is moderate. The content of organic matter is moderate to high, and natural fertility is medium.

Most areas of this soil are used for row crops and are well suited to this use. Corn, soybeans, wheat, and oats are the common crops. Conservation tillage and contour farming help to control erosion. Droughtiness causes crop damage in years with low rainfall, and irrigation improves the suitability for crops. Delaying tillage until spring helps to reduce erosion caused by wind.

The suitability of this soil for trees and shrubs, especially drought-tolerant species, in windbreaks is good. Completion of site preparation in the spring before planting helps to reduce erosion caused by wind. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIe.

190—Hayfield loam. This soil is nearly level to gently sloping and moderately well drained to somewhat poorly drained. It is on convex side slopes and ridgetops of gentle rises on outwash plains and stream terraces. The areas are irregular in shape and range from 2 to about 40 acres.

Typically, the surface layer is very dark gray, friable loam about 8 inches thick. The subsurface layer is dark grayish brown, mottled, friable loam about 5 inches thick. The subsoil is brown, mottled, friable loam about 16 inches thick. The underlying material to a depth of about 60 inches is yellowish brown, mottled, loose coarse sand. In places the surface layer is thicker and darker colored or the subsoil is more grayish.

Included with this soil in mapping are small areas of the poorly drained Marshan soils in depressions and drainageways. Included soils make up 5 to 15 percent of the map unit.

Permeability in this Hayfield soil is moderate in the upper part and rapid in the underlying material. Surface runoff is slow, and available water capacity is moderate. The content of organic matter also is moderate, and natural fertility is medium. The seasonal high water table is at a depth of 2.5 to 5.0 feet.

Most areas of this soil are used for row crops and small grains and are well suited to those uses. The common crops are corn, soybeans, wheat, oats, and some canning crops such as peas, sweet corn, and pumpkins. Droughtiness is a hazard to deep-rooted crops in years with low rainfall, and irrigation improves the suitability for crops. Tile drainage improves suitability and workability of the soil in some areas. Delayed tillage until spring and conservation tillage help to reduce soil blowing.

The suitability of this soil for trees and shrubs, especially drought-tolerant species, in windbreaks is good. Drainage lowers the seasonal high water table and provides a deeper root zone in the spring and during wet periods. Completion of site preparation before planting reduces plant competition. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIs.

228B—Mottland loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on ridgetops and side slopes of bedrock-controlled uplands. The areas are irregular in shape and range from 3 acres to about 150 acres.

Typically, the surface layer is black, friable loam about 7 inches thick. The underlying material to a depth of about 60 inches is yellowish brown, friable channery loam that is 20 to 30 percent soft weathered limestone channers. In places the surface layer is channery.

Included with this soil in mapping are small areas of the moderately well drained Terril soils in narrow drainageways and the well drained Rossfield soils on ridgetops. Included soils make up 5 to 15 percent of the map unit.

Permeability in this Mottland soil is moderate in the upper part and moderately rapid in the underlying material. Surface runoff is medium. Available water capacity is moderate. Organic matter content is low. Natural fertility is medium.

Most areas of this soil are used for row crops or pasture. The common crops are corn, soybeans, oats, wheat, and alfalfa. Early-maturing crops, such as small grains, are best suited to this soil because of the hazard of late-season droughtiness, and irrigation improves the suitability for crops. Conservation tillage and contour farming help to reduce the hazard of erosion.

Controlled grazing, using nitrogen fertilizer, and interseeding native stands with birdsfoot trefoil and ladino are the main pasture management practices.

The suitability of this soil for trees and shrubs, mainly drought-tolerant species, in windbreaks is fair. Completion of site preparation in the spring before planting reduces erosion. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIe.

228C—Mottland loam, 6 to 12 percent slopes. This soil is sloping and well drained. It is on side slopes and on ridgetops of bedrock-controlled uplands. The areas are irregular in shape and range from 3 acres to about 150 acres.

Typically, the surface layer is very dark brown, friable loam about 7 inches thick. The subsoil is yellowish brown, friable channery loam about 6 inches thick. The underlying material to a depth of about 60 inches is yellowish brown, friable channery sandy loam that is 20 to 30 percent soft weathered limestone channers. In many places the surface layer is channery loam. In a few places slopes are as much as 20 percent.

Included with this soil in mapping are small areas of the moderately well drained Terril soils in narrow drainageways. Included soils make up 5 to 15 percent of the map unit.

Permeability in this Mottland soil is moderate in the upper part and moderately rapid in the lower part. Surface runoff is medium to rapid. Available water capacity is moderate. Organic matter content is low. Natural fertility is medium.

Most areas of this soil that are in pasture are closely grazed and support cool-season Kentucky bluegrass. The main limitations of the soil for such pastures are the available water capacity and the tendency to warm up quickly in the spring, causing early dormancy. Besides using controlled grazing, two practices that increase the amount of forage are: (1) using drought-tolerant species such as western wheatgrass, which can be grazed early in the spring, and sideoats grama and little bluestem, which can be grazed from mid to late summer; and (2) interseeding with legumes such as red clover, ladino, or birdsfoot trefoil.

The suitability of this soil for trees and shrubs, mainly drought-tolerant species, in windbreaks is fair. Completion of site preparation in the spring before planting helps to reduce erosion. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IVe.

244A—Lilah sandy loam, 0 to 2 percent slopes. This soil is nearly level and excessively drained. It is on plane to slightly convex low rises on benches along streams extending into uplands. The areas are irregular in shape and range from 5 to about 200 acres.

Typically, the surface layer is very dark grayish brown, friable sandy loam about 10 inches thick. The subsoil is about 28 inches thick. The upper part of the subsoil is brown, friable sandy loam; the lower part is brown, loose gravelly loamy sand. The underlying material to a depth of about 60 inches is yellowish brown, loose gravelly coarse sand. In places the surface layer and upper part of the subsoil are loam or silt loam. In a few other places the surface layer is thicker or the water table is at a depth of less than 6 feet.

Included with this soil in mapping are small areas of the moderately well drained Hayfield soils in shallow depressions. Also included are the poorly drained Marshan soils and very poorly drained Shandep soils in drainageways and depressions. Included soils make up 2 to 15 percent of the map unit.

Permeability in this Lilah soil is moderately rapid in the upper part and very rapid in the lower part. Surface runoff is medium, and available water capacity is low. Organic matter content and natural fertility also are low.

Most areas of this soil are used for row crops, especially small grains and hay, but the soil has poor suitability for this use. Late-season droughtiness is a hazard to crops. Irrigation improves the suitability for crops on this soil; however, frequent applications are necessary. Delaying tillage until spring, using crop residue, and maintaining a plant cover reduce soil blowing.

Most areas of this soil that are in pasture are closely grazed and support cool-season Kentucky bluegrass. The main limitations of the soil for such pastures are the available water capacity and the tendency to warm up quickly in the spring, causing early dormancy. Besides using controlled grazing, two practices that increase the amount of forage are: (1) using drought-tolerant species such as western wheatgrass, which can be grazed early in the spring, and sideoats grama and little bluestem, which can be grazed from mid to late summer; and (2) interseeding with legumes such as red clover, ladino, or birdsfoot trefoil.

The suitability of this soil for trees and shrubs, mainly drought-tolerant species, in windbreaks is fair. Completion of site preparation in the spring before planting helps to reduce erosion caused by wind. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IVs.

244B—Lilah sandy loam, 2 to 6 percent slopes. This soil is gently sloping and excessively drained. It is on knolls on uplands and on parts of stream terraces. The areas are irregular in shape and range from 3 acres to about 30 acres.

Typically, the surface layer is very dark grayish brown, friable sandy loam about 8 inches thick. The subsoil is about 28 inches thick. The upper part of the subsoil is brown, friable sandy loam, and the lower part is brown, loose gravelly loamy sand. The underlying material to a depth of about 60 inches is yellowish brown, loose gravelly coarse sand. In places the surface layer and upper part of the subsoil are loam or silt loam.

Included with this soil in mapping are small areas of the moderately well drained Terril soils in drainageways.

Included soils make up 2 to 15 percent of the map unit.

Permeability in this Lilah soil is moderately rapid in the upper part and very rapid in the lower part. Surface runoff is medium, and available water capacity is low. Organic matter content and natural fertility also are low.

Most areas of this soil are used for row crops, especially small grains and hay, but the soil has poor suitability for this use. Late-season droughtiness is a hazard to crops. Irrigation improves the suitability for crops on this soil; however, frequent applications are necessary. Delaying tillage until spring, using crop residue, and maintaining a plant cover help to reduce soil blowing.

Most areas of this soil that are in pasture are closely grazed and support cool-season Kentucky bluegrass. The main limitations of the soil for such pastures are the available water capacity and the tendency to warm up quickly in the spring, causing early dormancy. Besides using controlled grazing, two practices that increase the amount of forage are: (1) using drought-tolerant species such as western wheatgrass, which can be grazed early in the spring, and sideoats grama and little bluestem, which can be grazed from mid to late summer; and (2) interseeding with legumes such as red clover, ladino, or birdsfoot trefoil.

The suitability of this soil for trees and shrubs, mainly drought-tolerant species, in windbreaks is fair. Completion of site preparation in the spring before planting helps to reduce erosion caused by wind. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IVs.

244C—Lilah sandy loam, 6 to 12 percent slopes. This soil is sloping and excessively drained. It is on ridgetops and side slopes on knolls and escarpments of stream terraces. The areas are irregular in shape and range from 3 acres to about 30 acres.

Typically, the surface layer is very dark grayish brown, very friable sandy loam about 6 inches thick. The subsoil is about 24 inches thick. The upper part of the subsoil is brown, friable sandy loam; the lower part is brown, loose gravelly loamy sand. The underlying material to a depth of about 60 inches is yellowish brown, loose gravelly coarse sand. In places the surface layer is loam or gravelly sandy loam or is thicker.

Included with this soil in mapping are small areas of the moderately well drained Terril soils in drainageways. Included soils make up 2 to 15 percent of the map unit.

Permeability in this Lilah soil is moderately rapid in the upper part and very rapid in the lower part. Surface runoff is medium to rapid. Available water capacity is low. Organic matter content and natural fertility also are low.

Many areas of this soil are used for cultivated crops or hay, but the soil is generally unsuited to cropland because of slope. The common crops are corn, soybeans, oats, wheat, and alfalfa.

Some areas of this soil that are in pasture are closely grazed and support cool-season Kentucky bluegrass. The main limitations of the soil for such pastures are the available water capacity and the tendency to warm up quickly in the spring, causing early dormancy. Besides using controlled grazing, two practices that increase the amount of forage are: (1) using drought-tolerant species such as western wheatgrass, which can be grazed early in the spring, and sideoats grama and little bluestem, which can be grazed from mid to late summer; and (2) interseeding with legumes such as red clover, ladino, or birdsfoot trefoil.

The suitability of this soil for trees and shrubs, mainly drought-tolerant species, in windbreaks is fair. Completion of site preparation in the spring before planting helps to reduce erosion caused by wind. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is VIs.

252—Marshan clay loam. This soil is nearly level and poorly drained. It is in shallow depressions, in drainageways, and in low parts of outwash plains and stream terraces. The areas are irregular in shape and range from 2 to about 100 acres.

Typically, the surface layer is black, friable clay loam about 10 inches thick. The subsurface layer is very dark gray, friable clay loam about 14 inches thick. The subsoil is about 15 inches thick. It is dark gray and gray, mottled, friable clay loam in the upper part and dark gray, mottled, friable sandy loam in the lower part. The underlying material to a depth of about 60 inches is grayish brown and yellowish brown, mottled, loose coarse sand and gravelly coarse sand. In places, especially in scour channels, the surface layer is gravelly sandy loam. In some other places the underlying material is loam or very fine sandy loam and is underlain by soft limestone bedrock at about 6 to 8 feet.

Included with this soil in mapping are small areas of the poorly drained Mayer soils on slight rises and the poorly drained Faxon Variant soils in shallow drainageways and depressions. Included soils make up 2 to 10 percent of the units.

Permeability in this Marshan soil is moderately rapid in the upper part and very rapid in the underlying material. Surface runoff is slow. Available water capacity is moderate. Organic matter content and natural fertility are high. The seasonal high water table is at a depth of 1.0 to 2.5 feet.

Most areas of this soil have been drained and are used for row crops. They are well suited to this use. The common crops are corn and soybeans. Tile drainage improves suitability for crops, improves workability, and allows the soil to warm up early in spring. In places the ground water contains enough iron oxide to seal tile lines. Fall tillage improves spring seedbeds because frost action breaks up the clods.

The suitability of this soil for trees and shrubs, mainly wetness-tolerant species, in windbreaks is fair. Drainage lowers the seasonal high water table and provides a deeper root zone. Completion of site preparation is needed the fall before planting to reduce plant competition and because in many years this soil is too wet to till in early spring. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIw.

253—Maxcreek silty clay loam. This soil is nearly level and poorly and very poorly drained. It is in shallow depressions and drainageways on moraines. The areas are irregular in shape and range from 2 to about 60 acres.

Typically, the surface layer is black, friable silty clay loam about 10 inches thick. The subsurface layer is very dark gray, friable silty clay loam about 8 inches thick. The subsoil is about 17 inches thick. The upper part of the subsoil is dark gray, mottled, friable silt loam, and the lower part is olive gray, mottled, friable loam. The underlying material to a depth of about 60 inches is olive gray, mottled, friable, calcareous loam. A thin discontinuous coarse textured layer up to 5 inches thick commonly separates the upper part of the subsoil from the lower part.

Included with this soil in mapping are small areas of the poorly drained Havana and Canisteo soils around the rim of depressions. Also included are the moderately well to somewhat poorly drained Merton soils and moderately well drained Newry soils on slight rises and the very poorly drained Palms soils in small depressions. Included soils make up 2 to 15 percent of the unit.

Permeability in this Maxcreek soil is moderate. Surface runoff is slow. Available water capacity is high. Organic matter content and natural fertility are high. A seasonal high water table is at a depth of 1 to 3 feet.

Most areas of this soil are used for cultivated crops and are well suited to this use. The common crops are corn, soybeans, oats, and wheat. Some areas are in pasture. Tile drainage improves the suitability for crops, improves workability, and enables the soil to warm up earlier in the spring. Fall tillage improves spring seedbeds because frost action breaks up the clods.

The suitability of this soil for trees and shrubs, mainly wetness-tolerant species, in windbreaks is fair. Drainage lowers the seasonal high water table and provides a deeper root zone. Completion of site preparation is needed the fall before planting because in many years the soil is too wet to till in early spring. Shallow cultivation and herbicides help to control weeds and grass in newly established windbreaks.

The land capability classification is IIw.

255—Mayer loam. This soil is nearly level and poorly drained. It is in drainageways and on gentle rises above shallow depressions on outwash plains and stream terraces. The areas are irregular in shape and range from 2 to about 50 acres.

Typically, the surface layer is black, friable, calcareous loam about 8 inches thick. The subsurface layer is about 12 inches thick. It is black, friable, calcareous loam in the upper part and very dark gray, friable, calcareous loam in the lower part. The subsoil is about 16 inches thick. The upper part of the subsoil is olive gray, mottled, friable, calcareous loam; the middle part is olive gray, mottled, friable, calcareous sandy clay loam; the lower part is olive, calcareous sandy loam. The underlying material to a depth of about 60 inches is dark brown, mottled, loose, calcareous gravelly coarse sand. In places the surface layer does not have carbonates, and in a few other places it is thinner and lighter colored.

Included with this soil in mapping are small areas of the poorly drained Marshan soils and very poorly drained Shandep soils in depressions. Also included are the very poorly drained Maxcreek and Palms soils in drainageways and depressions. Included soils make up 2 to 10 percent of the unit.

Permeability in this Mayer soil is moderate in the upper part and rapid in the underlying material. Surface runoff is slow. Available water capacity is moderate. Organic matter content is high. Natural fertility is moderate. The seasonal high water table is at a depth of 1 to 3 feet.

Most areas of this soil have been drained and are used for row crops. They are well suited to this use. The common crops are corn and soybeans. Tile drainage improves suitability for crops, improves workability, and allows the soil to warm up early in spring. In places the ground water contains enough iron oxide to seal tile lines. Fall tillage improves spring seedbeds because frost action breaks up the clods.

The suitability of this soil for trees and shrubs, mainly wetness-tolerant species, in windbreaks is fair. Drainage lowers the seasonal high water table and provides a deeper root zone. Completion of site preparation is needed the fall before planting to reduce plant competition and because in many years this soil is too wet to till in early spring. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIw.

295—Readlyn silt loam. This soil is nearly level and somewhat poorly drained. It is on convex side slopes and ridgetops on till plains. The areas are irregular in shape and range from 2 to 40 acres.

Typically, the surface layer is black, friable silt loam about 8 inches thick. The subsurface layer is black and very dark grayish brown, friable silt loam about 9 inches thick. The subsoil is about 30 inches thick. It is dark brown, mottled, friable silt loam in the upper part; dark yellowish brown, mottled, firm loam in the middle part; and yellowish brown, mottled, firm loam in the lower part. The underlying material to a depth of about 60 inches is yellowish brown mottled, firm, calcareous loam. In places the surface layer is silty clay and the subsoil is olive gray. In a few other places the surface layer is thinner and lighter colored. A coarse textured layer up to 6 inches thick commonly separates the upper part of the subsoil from the lower part.

Included with this soil in mapping are small areas of the well drained to moderately well drained Kenyon soils on convex side slopes. Included soils make up 5 to 15 percent of the unit.

Permeability in this Readlyn soil is moderate. Surface runoff is medium. Available water capacity is high. Organic matter content and natural fertility also are high. The seasonal high water table is at a depth of 2 to 4 feet.

Most areas of this soil are used for cultivated crops and are well suited to this use. The common crops are corn and soybeans. Tile drainage enables the soil to warm up earlier in the spring and improves workability in some areas. Using crop residue and conservation tillage reduce crusting of the surface after heavy rains and help to control erosion.

The suitability of this soil for trees and shrubs in windbreaks is good. Completion of site preparation the fall before planting reduces plant competition. In some years tilling this soil in early spring causes clodding. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is I.

307—Sargeant silt loam. This soil is nearly level and somewhat poorly drained. It is on convex low ridges on till plains. The areas are irregular in shape and range from 3 acres to about 100 acres.

Typically, the surface layer is dark gray, friable silt loam about 8 inches thick. The subsurface layer is light brownish gray and grayish brown, friable silt loam about 14 inches thick. It is mottled in the upper part. The next layer is yellowish brown, mottled, friable sandy loam about 6 inches thick. The subsoil is yellowish brown, mottled, firm loam about 17 inches thick. The underlying material to a depth of about 60 inches is yellowish brown, mottled, firm loam. In places the surface layer is thicker and contains more clay. In a few other places up to 18 inches of stratified loamy sand and sandy loam is in the lower part of the subsoil or the underlying material contains more clay.

Included with this soil in mapping are small areas of the moderately well drained Vlasaty and Kasson soils on higher ridgetops. Also included are the poorly drained Brownsdale soils on slightly concave foot slopes or in drainageways. Included soils make up 5 to 15 percent of the map unit.

Permeability in this Sargeant soil is moderate in the upper part and slow in the lower part. Surface runoff is slow. Available water capacity is high. Organic matter content is moderately low to moderate, and natural fertility is medium. The seasonal high water table is perched at a depth of 6 to 18 inches.

Most areas of this soil are used for cultivated crops, and they have fair suitability for this use. The common crops are corn and soybeans. Wetness is the main management concern. Cloddiness of the surface layer is common if the soil is worked when wet. Tile drains, closely spaced to overcome the permeability, improve the suitability for crops, improve workability, and enable the soil to warm up earlier in the spring. Conservation tillage, ridge tillage, and crop residue in and on the soil help to reduce erosion and prevent puddling on and crusting of the surface after heavy rains. Fall tillage helps to improve the seedbed because frost action breaks up the clods.

The suitability of this soil for trees and shrubs, especially water- and acid-tolerant species, is fair to poor. Drainage lowers the seasonal high water table and provides a deeper root zone for trees. Completion of site preparation is needed in the fall because the soil commonly is too wet to work in the spring. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIIw.

313—Spillville loam, occasionally flooded. This soil is nearly level and moderately well drained. It is on flood plains along outwash plains and stream terraces. The areas are long and narrow and range from 5 to about 50 acres.

The surface layer is very dark brown, friable loam about 9 inches thick. The next layer is black, very dark brown, and very dark grayish brown, friable loam. The underlying material to a depth of about 60 inches is very dark grayish brown, friable sandy loam. In places the underlying material is sand or loamy sand.

Included with this soil in mapping are small areas of the poorly drained and very poorly drained Kalmarville soils on slightly lower landscape positions and the very poorly drained Shandep soils in depressions. Included soils make up 5 to 10 percent of the map unit.

Permeability in this Spillville soil is moderate in the upper part and moderately rapid in the substratum. Surface runoff is slow. Available water capacity is high. Organic matter content and natural fertility are high. The seasonal high water table is at a depth of 3 to 5 feet.

Most areas of this soil are used for row crops and are well suited to that use. The common crops are corn and soybeans. Flooding damages crops in some years. Delaying spring planting helps to prevent damage from flooding. Tile drainage improves the suitability for crops, improves workability, and enables the soil to warm up earlier in the spring; however, in some years tile drains are ineffective because outlets are inundated by flooding.

The areas that are inaccessible for cropland are used for pasture or woodland or are idle. Controlling weeds and grazing and using fertilizer are the main management practices in the pastures, which mostly consist of cool-season bluegrass.

A wide variety of trees and shrubs is suitable for windbreaks and environmental plantings on this soil. Shallow cultivation and herbicides help to control competing vegetation.

The land capability classification is IIw.

331—Tripoli silty clay loam. This soil is nearly level and poorly drained. It is in slightly concave to plane, shallow depressions and drainageways on till plains. The areas are irregular in shape and range from 2 acres to about 80 acres.

Typically, the surface layer is black, friable silty clay loam about 10 inches thick. The subsurface layer is black, friable silty clay loam about 16 inches thick. The subsoil is about 31 inches thick. It is olive gray, mottled, friable silty clay loam in the upper part and olive gray and olive brown, mottled, firm loam in the lower part. The underlying material to a depth of 60 inches is olive brown, mottled, firm loam. In places the subsoil contains less grayish material. In a few other places the surface layer is thinner and lighter colored or the underlying material is friable, stratified loamy to sandy sediments. A coarse textured layer up to 6 inches thick commonly separates the upper part of the subsoil from the lower part.

Included with this soil in mapping are small areas of the somewhat poorly drained Oran soils on adjacent convex side slopes. Included soils make up 2 to 15 percent of the unit.

Permeability in this soil is moderate. Surface runoff is slow. Available water capacity is high. Organic matter content and natural fertility also are high. The seasonal high water table is at a depth of 1 to 2 feet.

Most areas of this soil are used for cropland and are well suited to this use. The common crops are corn and soybeans (fig. 5). Wetness is the main management concern. Tile drainage improves the suitability of the soil for crops, improves workability, and enables the soil to warm up earlier in the spring. Fall tillage improves spring seedbeds because frost action breaks up the clods.

The suitability of this soil for trees and shrubs, mainly wetness-tolerant species, in windbreaks is fair. Drainage lowers the seasonal high water table and provides a deeper root zone. Completion of site preparation is needed in the fall before planting to reduce plant competition and because in many years this soil is too wet to till in early spring. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIw.

334B—Vlasaty silt loam, 1 to 4 percent slopes. This soil is gently sloping and moderately well drained. It is on convex side slopes and ridgetops on till plains. The areas are irregular in shape and range from 3 acres to about 50 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsurface layer is grayish brown, friable silt loam about 4 inches thick. The subsoil is about 39 inches thick. It is brown, mottled, friable silty clay loam in the upper part; brown, mottled, firm clay loam in the middle part; and yellowish brown, mottled, firm clay loam in the

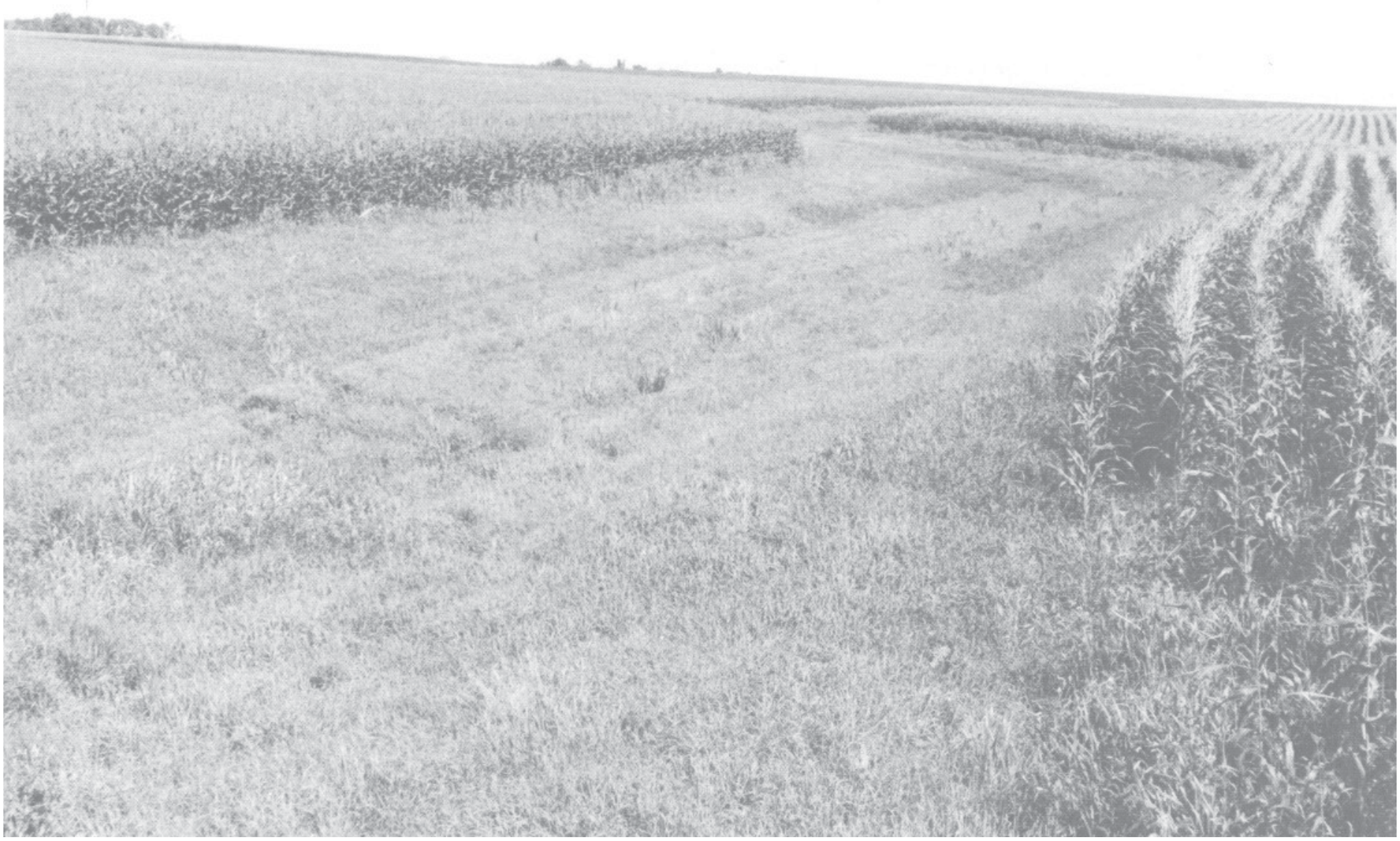

Figure 5.—A grassed waterway in a cornfield in an area of Tripoli silty clay loam.

lower part. The underlying material to a depth of about 60 inches is yellowish brown, mottled, firm loam. In places the surface layer has been eroded and contains many pebbles and cobblestones. In a few other places the subsoil contains more clay.

Included with this soil in mapping are small areas of the well drained Dowagiac soils on low ridges and the poorly drained Tripoli soils in shallow depressions and drainageways. Included soils make up 10 to 15 percent of the map unit.

Permeability in this Vlasaty soil is moderately slow. Surface runoff is medium. Available water capacity is high. Organic matter content is moderately low to moderate. Natural fertility is medium. The seasonal high water table is at a depth of 1.5 to 3.0 feet.

Most areas of this soil are used for cultivated crops and are well suited to this use. The common crops are corn and soybeans. Conservation tillage and contour farming reduce erosion on this soil. Crop residue in and on the soil and conservation tillage help to prevent puddles on and crusting of this soil after heavy rains. Tile drainage helps to improve the suitability for crops in some areas of this soil.

The suitability of this soil for trees and shrubs in windbreaks is good. Completion of site preparation is needed the fall before to control weeds and because tilling in early spring may cause clod formation. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIe.

376B—Moland silt loam, 1 to 6 percent slopes. This soil is gently sloping and well drained. It is on convex ridgetops and side slopes on knolls that are on moraines. The areas are irregular in shape and range from 2 acres to about 30 acres.

Typically, the surface layer is very dark brown, friable silt loam about 7 inches thick. The subsurface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 31 inches thick. The upper part of the subsoil is dark brown, friable loam; the middle part is yellowish brown, friable loam; and the lower part is light olive brown, mottled, friable loam. The underlying material to a depth of about 60 inches is light olive brown, mottled, friable, calcareous loam. A coarse textured layer up to 6 inches thick commonly separates the upper part of the subsoil from the lower part.

Included with this soil in mapping are small areas of the moderately well drained to somewhat poorly drained Merton soils on nearly level areas and the poorly drained Maxcreek soils in depressions and drainageways. Included soils make up 5 to 15 percent of the unit.

Permeability in this Moland soil is moderate. Surface runoff is medium. Available water capacity is high. Organic matter content and natural fertility also are high.

Most areas of this soil are used for row crops and are well suited to this use. The common crops are corn, soybeans, and oats. Conservation tillage, crop residue in and on the soil, contour farming, and hay crops help to control erosion and prevent puddles on and crusting of the soil after heavy rains.

The suitability of this soil for trees and shrubs in windbreaks is good. Completion of site preparation the fall before planting helps to reduce plant competition. In some years tilling this soil in early spring causes clod formation. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIe.

377—Merton silt loam. This soil is nearly level to gently sloping and moderately well drained to somewhat poorly drained. It is on convex ridgetops and side slopes of low knolls and slight rises on moraines. The areas are irregular in shape and range from 2 acres to about 40 acres.

Typically, the surface layer is black, friable silt loam about 8 inches thick. The subsurface layer is very dark brown, friable silt loam about 8 inches thick. The subsoil is about 28 inches thick. It is dark grayish brown, friable silt loam in the upper part; grayish brown, mottled, friable loam in the middle part; and light olive brown, mottled, friable loam in the lower part. The underlying material to a depth of about 60 inches is light olive brown, mottled, friable, calcareous loam. In places the surface layer is thinner and lighter colored. A coarse textured layer up to 6 inches thick commonly separates the upper part of the subsoil from the lower part.

Included with this soil in mapping are small areas of the poorly drained Maxcreek soils in shallow depressions and drainageways and the well drained Blooming and Moland soils on more sloping, convex areas. Included soils make up 5 to 15 percent of the unit.

Permeability in this Merton soil is moderate. Surface runoff is medium. Available water capacity is high. Organic matter content and natural fertility also are high. The seasonal high water table is at a depth of 2 to 5 feet.

Most areas of this soil are used for cultivated crops and are well suited to this use. The common crops are corn and soybeans. Crop residue in and on the soil and conservation tillage reduce erosion and help to prevent puddles on and crusting of the soil after heavy rains. Tile drainage improves the suitability for crops in some areas.

The suitability of this soil for trees and shrubs in windbreaks is good. Completion of site preparation is needed the fall before planting to reduce plant competition and because tilling this soil in early spring causes clod formation. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is I.

380—Havana silt loam. This soil is nearly level and poorly drained. It is on low rises and in shallow depressions on low areas on moraines. The areas are irregular in shape and range from 3 acres to about 100 acres.

Typically, the surface layer is very dark brown, friable silt loam about 8 inches thick. The subsurface layer is dark gray, friable silt loam about 3 inches thick. The subsoil is about 29 inches thick. The upper part of the subsoil is grayish brown, mottled, friable silt loam and silty clay loam, and the lower part is grayish brown, mottled, friable loam. The underlying material to a depth of about 60 inches is light olive brown, mottled, friable loam. In places the subsoil contains less grayish material or the surface layer is thicker and darker colored.

Included with this soil in mapping are small areas of the well drained Blooming and Moland soils on knolls and side slopes. Included soils make up 5 to 15 percent of the map unit.

Typically, the surface layer is very dark brown, friable silt loam about 8 inches thick. The subsurface layer is dark gray, friable silt loam about 3 inches thick. The subsoil is about 29 inches thick. The upper part of the subsoil is grayish brown, mottled, friable silt loam and silty clay loam, and the lower part is grayish brown, mottled, friable loam. The underlying material to a depth of about 60 inches is light olive brown, mottled, friable loam. In places the subsoil contains less grayish material or the surface layer is thicker and darker colored.

Included with this soil in mapping are small areas of the well drained Blooming and Moland soils on knolls and side slopes. Included soils make up 5 to 15 percent of the map unit.

Permeability in this Havana soil is moderately slow. Surface runoff is slow. Available water capacity is high. Organic matter content is moderate. Natural fertility is high. The seasonal high water table is at a depth of 1 to 3 feet.

Most areas of this soil are used as cropland and are well suited to this use. The common crops are corn, soybeans, and oats. Tile drainage improves the suitability for crops, workability, and warming of the soil in the spring. Returning crop residue reduces puddling on and crusting of this soil after heavy rains. Fall tillage improves spring seedbeds because frost action breaks up the clods.

The suitability of this soil for trees and shrubs in windbreaks is good. Completion of site preparation the fall before planting reduces plant competition. This soil is too wet in some years for tilling in early spring without causing clod formation. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIw.

381—Newry silt loam. This soil is nearly level to gently sloping and moderately well drained. It is on convex ridgetops and side slopes of low knolls and on slight rises on moraines. The areas are irregular in shape and range from 2 acres to about 40 acres.

Typically, the surface layer is very dark brown, friable silt loam about 7 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is about 29 inches thick. The upper part of the subsoil is dark brown, friable silty clay loam, and the lower part is brown and light olive brown, mottled, friable loam. The underlying material to a depth of about 60 inches is light olive brown, friable, calcareous loam. In places the subsoil contains more grayish material. In a few other places the subsoil has no mottles and is bright yellowish brown or a coarse textured layer commonly separates the upper part of the subsoil from the lower part.

Included with this soil in mapping are small areas of the poorly drained Canisteo and Maxcreek soils in shallow depressions and drainageways. Included soils make up 5 to 15 percent of the unit.

Permeability in this Newry soil is moderate. Surface runoff is medium. Available water capacity is high. Organic matter content is moderate. Natural fertility is high. The seasonal high water table is at a depth of 2 to 5 feet.

Most areas of this soil are used for row crops and are well suited to this use. The common crops are corn, soybeans, and small grains. Crop residue in and on the soil and conservation tillage help prevent puddling on and crusting of the soil after heavy rains and help to reduce erosion. Tile drainage improves the suitability for crops in some areas.

The suitability of this soil for trees and shrubs in windbreaks is good. Completion of site preparation the fall before planting helps to reduce plant competition. This soil is too wet in some years for tilling in early spring without causing clod formation. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is I.

382B—Blooming silt loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on convex ridgetops and side slopes on moraines. The areas of this unit are irregular in shape and range from 3 acres to about 30 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 37 inches thick. The upper part of the subsoil is dark brown, friable silt loam and silty clay loam, and the lower part is yellowish brown and light olive brown, friable loam. The underlying material to a depth of about 60 inches is light olive brown, friable, calcareous loam. In places the subsoil is mottled.

Included with this soil in mapping are small areas of the poorly drained Maxcreek soils in shallow depressions and drainageways and the poorly drained Havana soils in shallow depressions. Included soils make up 2 to 10 percent of the map unit.

Permeability in this Blooming soil is moderate.

Surface runoff is medium. Available water capacity is high. Organic matter content is moderate. Natural fertility is high.

Most areas of this soil are used for row crops and are well suited to this use. The common crops are corn, soybeans, and small grains. Conservation tillage and crop residue in and on the soil reduce erosion and help to prevent puddling on and crusting of the surface after heavy rains. Contour farming and contour stripcropping also reduce erosion.

The suitability of this soil for trees and shrubs in windbreaks is good. Completion of site preparation the fall before planting reduces plant competition. In some years tilling this soil in early spring causes clodding. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIe.

382C—Blooming silt loam, 6 to 15 percent slopes. This soil is sloping and well drained. It is on ridgetops and side slopes on moraines. The areas of this unit are irregular in shape and range from 3 acres to about 30 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 6 inches thick. The subsoil is about 33 inches thick. The upper part of the subsoil is dark brown, friable silt loam and silty clay loam; the lower part is yellowish brown and light olive brown, friable loam. The underlying material to a depth of about 60 inches is light olive brown, friable, calcareous loam. Some areas have a thicker, dark colored surface layer or have mottles in the subsoil. In places erosion has resulted in a thinner surface layer that contains numerous pebbles and cobblestones. In a few other places slopes are more than 15 percent.

Included with this soil in mapping are small areas of the poorly drained Maxcreek soils and moderately well drained Terril soils in drainageways. Included soils make up 2 to 10 percent of the map unit.

Permeability in this Blooming soil is moderate. Surface runoff is medium. Available water capacity is high. Organic matter content is moderate. Natural fertility is high.

Most areas of this soil are used for cropland and have fair suitability for this use. The common crops are corn, soybeans, small grains, and hay. Some areas are in pasture or woodland. Erosion can be reduced on this soil by contour stripcropping or growing hay crops or, in areas where slopes are long and uniform, by contour farming.

The suitability of this soil for trees and shrubs in windbreaks is good. Drainage lowers the seasonal high water table and provides a deeper root zone in spring and during wet periods. Completion of site preparation before planting reduces plant competition. Shallow cultivation and herbicides help control weeds and grasses in newly established windbreaks.

The land capability classification is IIIe.

393—Udolpho silt loam. This soil is nearly level and poorly drained. It is on plane to slightly concave areas of outwash plains and stream terraces. This soil is subject to rare flooding. The areas are irregular in shape and range from 2 acres to about 60 acres.

Typically, the surface layer is very dark grayish brown, very friable silt loam about 8 inches thick. The subsurface layer is grayish brown, very friable silt loam about 5 inches thick. The subsoil is about 14 inches thick. The upper part of the subsoil is grayish brown, mottled, friable loam, and the lower part is grayish brown, mottled, very friable loam. The underlying material to a depth of about 60 inches is mottled, grayish brown, loose gravelly coarse sand. In some areas a seasonal high water table is perched at a depth of 7 to 10 feet. In a few places the surface layer is thicker and darker colored or the subsoil contains less grayish material.

Included with this soil in mapping are small areas of the well drained Dowagiac and Fairhaven soils on small knolls and on side slopes. Included soils make up 2 to 12 percent of the map unit.

Permeability in this Udolpho soil is moderate in the upper part and rapid in the underlying material. Surface runoff is slow. Available water capacity is moderate. Organic matter content is moderate, and natural fertility is medium. The seasonal high water table is at a depth of 1 to 3 feet.

Most areas of this soil are used for row crops or small grains. They are well suited to those uses. The common crops are corn, soybeans, wheat, and oats. Tile drainage improves the suitability for crops, improves workability, and enables the soil to warm up earlier in the spring. Crop residue in and on the soil and conservation tillage reduce puddling on and crusting of the soil and reduce soil blowing.

The suitability of this soil for trees and shrubs in windbreaks is good. Drainage lowers the seasonal high water table and provides a deeper root zone in the spring and during wet periods. Completion of site preparation before planting helps to reduce plant competition. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIw.

444—Canisteo silty clay loam. This soil is nearly level and poorly drained. It is in plane to concave, shallow depressions and drainageways on moraines. The areas are irregular in shape and range from 2 acres to about 60 acres.

Typically, the surface layer is black, friable, calcareous silty clay loam about 8 inches thick. The subsurface layer is black, friable, calcareous silty clay loam about 6 inches thick. The next layer is very dark gray, friable silty clay loam about 7 inches thick. The subsoil is about 14 inches thick. The upper part of the subsoil is olive gray, friable, calcareous silt loam, and the lower part is olive gray, mottled, friable, calcareous loam. The underlying material to a depth of about 60 inches is olive gray, mottled, friable, calcareous loam. In places the surface layer does not have carbonates or is thinner and lighter colored. A discontinuous coarse textured layer up to 5 inches thick commonly separates the upper part of the subsoil from the lower part.

Included with this soil in mapping are small areas of the moderately well to somewhat poorly drained Merton soils on slight rises and the very poorly drained Maxcreek and Palms soils in small depressions. Included soils make up 2 to 15 percent of the unit.

Permeability in this Canisteo soil is moderate. Surface runoff is slow. Available water capacity is high. Organic matter content and natural fertility also are high. The seasonal high water table is at a depth of 1 to 3 feet.

Most areas of this soil are used as cropland and are well suited to this use. The common crops are corn, soybeans, oats, and wheat. Tile drainage improves the suitability for crops, improves workability, and enables the soil to warm up earlier in the spring. Fall tillage improves spring seedbeds because frost action breaks up the clods.

The suitability of this soil for trees and shrubs, mainly those that are tolerant of wet, calcareous soil, in windbreaks is fair. Drainage lowers the seasonal high water table and provides a deeper root zone. Because of spring wetness, completion of site preparation in the fall before planting helps to reduce plant competition. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIw.

465—Kalmarville loam, frequently flooded. This soil is nearly level and poorly and very poorly drained. It is on flood plains along outwash plains, stream terraces, and rivers. The areas are long and narrow and range from 3 acres to about 50 acres.

Typically, the surface layer is very dark brown, friable loam about 10 inches thick. The subsurface layer is stratified and about 40 inches thick. It is very dark brown, very friable fine sandy loam, sandy loam, and silt loam. The underlying material to a depth of about 60 inches is stratified, dark grayish brown loose sand and loamy fine sand. The texture is variable because of stream overflow, scouring, and changes in stream channels. In places the surface layer or underlying material is finer textured.

Included with this soil in mapping are small areas of the very poorly drained Palms soils in depressions and the moderately well drained Spillville soils on slightly higher parts of the flood plains. Included soils make up 5 to 10 percent of the map unit.

Permeability in this Kalmarville soil is moderate and moderately rapid in the upper part and rapid in the lower part. Surface runoff is slow. Available water capacity is variable. Organic matter content is moderate. Natural fertility is low. The seasonal high water table is within a depth of 1 foot.

Most of these areas are idle, providing habitat for wildlife. Some areas are in pasture. The soil is poorly suited to cropland because of frequent flooding and wetness.

The partially drained areas of the soil are well suited to perennial water-tolerant grasses such as reed canarygrass and, especially, Garrison creeping foxtail.

Water-tolerant trees and shrubs are needed for windbreaks and environmental plantings on this soil. Wetness causes moderate seedling mortality and delays spring planting in some years. Cultivation or herbicides will help to remove competing vegetation.

The land capability classification is Vw.

467—Sawmill silty clay loam. This soil is nearly level and poorly drained. It is on flood plains. The areas of this soil range from 5 to 50 acres. They are subject to frequent flooding.

Typically, the surface layer is very dark brown, friable silty clay loam about 10 inches thick. The subsurface layer is very dark gray, mottled, friable silty clay loam about 10 inches thick. The next layer is very dark gray, friable silty clay loam about 9 inches thick. The subsoil is dark gray, mottled, friable silty clay loam about 7 inches thick. The underlying material to a depth of about 60 inches is gray, friable silty clay loam. In places sand and gravel are at a depth of as little as 45 inches.

Included with this soil in mapping are small areas of the very poorly drained Palms soils in drainageways and the moderately well drained Spillville soils adjacent to streams and drainageways. These included soils make up 5 to 10 percent of the map unit.

Permeability in this Sawmill soil is moderate. Surface runoff is slow. Available water capacity is high to very high. Reaction of the subsoil is slightly acid. Organic matter content is very high. Natural fertility is high. The water table is within a depth of 2 feet.

Most drained areas of this soil are cropland. The undrained and surface-drained areas are idle or used for pasture. Many areas of this soil are difficult to drain because of a lack of outlets. In some areas clogging of tile by iron oxide is a hazard. The undrained or partially drained areas are well suited to perennial water-tolerant grasses such as reed canarygrass and, especially, Garrison creeping foxtail.

Water-tolerant trees and shrubs are needed for windbreaks and environmental plantings on this soil. Wetness causes moderate seedling mortality and delays spring planting in some years. Cultivation or herbicides will help to remove competing vegetation.

The land capability classification is IIIw drained and is Vw undrained.

479—Floyd silt loam. This soil is nearly level to gently sloping and somewhat poorly drained. It is on low ridges and slightly concave foot slopes of till plains. The areas are irregular in shape and range from 2 acres to about 25 acres.

Typically, the surface layer is very dark brown, friable silt loam about 10 inches thick. The subsurface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 32 inches thick. The upper part is dark grayish brown, mottled, friable sandy clay loam, and the lower part is dark grayish brown, mottled, firm loam. The underlying material to a depth of about 60 inches is olive brown, mottled, firm loam. In places a layer of loamy sand up to 10 inches thick is at a depth of 24 inches. In a few other places the surface layer is thinner and lighter colored.

Included with this soil in mapping are small areas of the poorly drained Clyde soils in drainageways and the well drained Ostrander soils on top of low ridges. Included soils make up about 5 to 10 percent of the map unit.

Permeability in this Floyd soil is moderate. Surface runoff is medium. Available water capacity is high. Organic matter content and natural fertility also are high. The water table is at a depth of 2 to 4 feet.

Most areas of this soil are used for row crops and are well suited to this use. The common crops are corn and soybeans. Wetness is the main management concern. Tile drainage improves the suitability for crops, improves workability, and enables the soil to warm up early in the spring. Crop residue in and on the soil and conservation tillage reduce puddling on and crusting of the soil after heavy rains and help to control erosion.

The suitability of this soil for trees and shrubs in windbreaks is good. Completion of site preparation the fall before planting helps to reduce plant competition. In some years tilling this soil in early spring causes clod formation. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIw.

483A—Waukee loam, 0 to 2 percent slopes. This soil is nearly level and well drained. It is on plane to slightly convex areas of outwash plains and stream terraces. The areas are irregular in shape and range from 5 to about 60 acres.

Typically, the surface layer is very dark brown, friable loam about 9 inches thick. The subsurface layer is very dark brown, friable loam about 7 inches thick. The subsoil is about 16 inches thick. The upper part of the subsoil is dark brown, friable loam, and the lower part is brown, loose loamy sand. The underlying material to a depth of about 60 inches is brown and yellowish brown, loose gravelly sand and gravelly loamy coarse sand. In some areas the surface layer and subsoil are thinner and contain more sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Lawler soils in shallow depressions and the poorly drained Marshan and very poorly drained Shandep soils in drainageways. Included soils make up 10 to 15 percent of the map unit.

Permeability in this Waukee soil is moderate in the upper part and very rapid in the underlying material. Surface runoff is medium. Available water capacity is moderate. Organic matter content also is moderate. Natural fertility is medium.

Most areas of this soil are used for row crops and are well suited to this use. The common crops are corn, soybeans, oats, and wheat. Early-maturing crops, such as the small grains, are best suited to this soil because of late-season droughts. This soil is well suited to irrigation. Delayed tillage until spring and conservation tillage reduce soil blowing.

The suitability of this soil for trees and shrubs, mainly drought-tolerant species, in windbreaks is good. Completion of site preparation in the spring before planting helps to reduce soil blowing. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIs.

483B—Waukee loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on convex side slopes and ridgetops on outwash plains and low rises on stream terraces. The areas are irregular in shape and range from 3 acres to about 50 acres.

Typically, the surface layer is very dark brown, friable loam about 12 inches thick. The subsoil is about 14 inches thick. The upper part of the subsoil is dark brown, friable loam, and the lower part is brown to dark brown, loose gravelly loamy sand. The underlying material to a depth of about 60 inches is brown and yellowish brown, loose gravelly sand and loamy coarse sand. In places the surface layer and subsoil are sandy loam or are thinner.

Included with this soil in mapping are small areas of the somewhat poorly drained Lawler soils on nearly level areas and the poorly drained Marshan and very poorly drained Shandep soils in drainageways. Included soils make up 10 to 15 percent of the map unit.

Permeability in this Waukee soil is moderate in the upper part and very rapid in the underlying material. Surface runoff is medium. Available water capacity is moderate. Organic matter content also is moderate. Natural fertility is medium.

Most areas of this soil are used for row crops and are well suited to this use. The common crops are soybeans, oats, and wheat. Early-maturing crops, such as the small grains, are best suited to this soil because of late-season droughts. This soil is well suited to irrigation. Delayed tillage until spring and conservation tillage reduce soil blowing.

The suitability of this soil for trees and shrubs, mainly drought-tolerant species, in windbreaks is good. Completion of site preparation in the spring before planting helps to reduce soil blowing. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIe.

485—Lawler silt loam. This soil is nearly level and somewhat poorly drained. It is on plane to slightly concave areas of outwash plains and stream terraces. The areas are irregular in shape and range from 3 acres to about 80 acres.

Typically, the surface layer is black, very friable silt loam about 9 inches thick. The subsurface layer is very dark grayish brown, very friable silt loam about 5 inches thick. The subsoil is about 18 inches thick. The upper part of the subsoil is dark grayish brown, friable silt loam; the middle part is dark grayish brown, mottled, friable loam; and the lower part is grayish brown, mottled, very friable sandy loam. The underlying material to a depth of about 60 inches is grayish brown, loose gravelly coarse sand. In places the subsoil contains more grayish material.

Included with this soil in mapping are small areas of the well drained Dickinson, Dowagiac, and Waukee soils on slightly higher rises and convex side slopes and the poorly drained Marshan soils and very poorly drained Shandep soils in shallow depressions and drainageways. Included soils make up 10 to 15 percent of the map unit.

Permeability in this Lawler soil is moderate in the upper part and very rapid in the underlying material. Surface runoff is slow. Available water capacity is moderate. Organic matter content and natural fertility are high. The seasonal high water table is at a depth of 2 to 4 feet.

Most areas of this soil are used for row crops and small grains and are well suited to those uses. Corn, soybeans, oats, and wheat are the common crops. Early-maturing crops, such as the small grains, are best suited to this soil because of late-season droughtiness. This soil is well suited to irrigation. Tile drainage improves crop growth and workability during wet periods. Delaying tillage until spring helps prevent soil blowing.

The suitability of this soil for trees and shrubs, mainly drought-tolerant species, in windbreaks is good. Drainage lowers the seasonal high water table and provides a deeper root zone. Completion of site preparation before planting helps to reduce plant competition. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIs.

516A—Dowagiac loam, 0 to 2 percent slopes. This soil is nearly level and well drained. It is on plane to slightly convex areas of outwash plains and stream terraces. The areas are irregular in shape and range from 5 to about 60 acres.

Typically, the surface layer is very dark grayish brown, friable loam about 6 inches thick. The subsurface layer is grayish brown, friable loam about 5 inches thick. The subsoil is about 20 inches thick. The upper part of the subsoil is dark yellowish brown, friable loam and clay loam; the lower part is yellowish brown, very friable sandy loam. The underlying material to a depth of about 60 inches is dark yellowish brown and brown, loose coarse sand. In places the surface layer contains more sand and less clay.

Included with this soil in mapping are small areas of the somewhat poorly drained Cylinder and Lawler soils in shallow, slightly concave areas and the poorly drained Marshan soils and very poorly drained Shandep soils in shallow depressions and drainageways. Included soils make up 10 to 15 percent of the map unit.

Permeability in this Dowagiac soil is moderate in the upper part and rapid in the underlying material. Surface runoff is slow. Available water capacity is moderate. Organic matter content is moderately low to moderate. Natural fertility is medium.

Most areas of this soil are used for row crops and are well suited to this use. Corn, soybeans, wheat, and oats are the common crops. Early-maturing crops, such as the small grains, are best suited to this soil because of late-season droughtiness. This soil is well suited to irrigation. Conservation tillage and delaying tillage until spring reduce soil blowing.

The suitability of this soil for trees and shrubs, mainly drought-tolerant species, in windbreaks is good. Completing site preparation before planting helps to reduce soil blowing. Shallow cultivation and herbicides help to control weeds and grasses in new windbreaks.

The land capability classification is IIIs.

516B—Dowagiac loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on convex side slopes and ridgetops on outwash plains and low rises on stream terraces. The areas are irregular in shape and range from 3 acres to about 50 acres.

Typically, the surface layer is dark grayish brown, friable loam about 6 inches thick. The subsurface layer is brown, friable loam about 4 inches thick. The subsoil is about 20 inches thick. The upper part of the subsoil is dark yellowish brown, friable loam and clay loam, and the lower part is dark yellowish brown, friable sandy clay loam. The underlying material to a depth of about 60 inches is dark yellowish brown and brown, loose coarse sand. In places the surface layer contains more sand and less clay.

Included with this soil in mapping are small areas of the somewhat poorly drained Cylinder and Lawler soils in shallow concave areas and the poorly drained Marshan and very poorly drained Shandep soils in shallow depressions and drainageways. Included soils make up 10 to 15 percent of the map unit.

Permeability in this Dowagiac soil is moderate in the upper part and rapid in the underlying material. Surface runoff is medium. Available water capacity is moderate. Organic matter content is moderately low to moderate. Natural fertility is medium.

Most areas of this soil are used for row crops and are well suited to this use. The common crops are corn, soybeans, wheat, and oats. Conservation tillage, crop residue in and on the soil, and delaying tillage until spring reduces erosion and soil blowing. Early-maturing crops, such as oats and wheat, are best suited to this soil because of late-season droughtiness. This soil is well suited to irrigation.

The suitability of this soil for trees and shrubs, mainly drought-tolerant species, in windbreaks is good. Completion of site preparation in the spring before planting helps to reduce soil blowing. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIIe.

517—Shandep clay loam. This soil is nearly level and very poorly drained. It is in concave drainageways and depressions on outwash plains. The areas are irregular in shape and range from 2 to 80 acres. This soil is subject to ponding.

Typically, the surface layer is black, friable clay loam about 9 inches thick. The subsurface layer is black, friable clay loam about 12 inches thick. The next layer is very dark gray, friable clay loam about 8 inches thick. The subsoil is about 13 inches thick. The upper part of the subsoil is dark gray, mottled, friable loam, and the lower part is gray, very friable sandy loam. The underlying material to a depth of about 60 inches is dark grayish brown and grayish brown, loose coarse sand and gravelly coarse sand. In places the underlying material contains more clay and silt and less sand.

Included with this soil in mapping are small areas of the poorly drained Coland soils in drainageways and the very poorly drained Palms soils at the base of side slopes. Included soils make up 5 to 10 percent of the map unit.

Permeability in this Shandep soil is moderate in the upper part and rapid in the lower part. Surface runoff is very slow to ponded. Available water capacity is moderate. Organic matter content and natural fertility are high. The seasonal high water table is within a depth of 1 foot.

Most drained areas of this soil are used for corn and soybeans. The undrained or surface-drained areas are idle or used for pasture. Many areas of this soil are difficult to drain because of a lack of suitable tile outlets, and in some areas iron oxide clogs the tile. The undrained or partially drained areas are well suited to perennial water-tolerant grasses such as reed canarygrass and, especially, Garrison creeping foxtail.

Wetness-tolerant trees and shrubs are suitable for windbreaks on this soil. Wetness causes a high rate of seedling mortality. Shallow cultivation and herbicides help to remove competing vegetation.

The land capability classification is IIIw drained and Vw undrained.

539—Palms muck. This soil is nearly level and very poorly drained. It is on plane to concave areas in depressions and drainageways on moraines and outwash plains. The areas vary in shape and range from 5 to about 100 acres. This soil is subject to ponding.

Typically, the surface layer is black, very friable muck about 10 inches thick. The subsurface layer is black, very friable muck about 22 inches thick. The underlying material extends to a depth of about 60 inches. It is olive gray, mottled, friable clay loam in the upper part and dark gray, mottled, friable, calcareous silty clay loam in the lower part.

Included with this soil in mapping are small areas of the poorly drained Canisteo and Maxcreek soils on slightly higher areas and the poorly drained Sawmill soils on flood plains. Included soils make up 5 to 15 percent of the map unit.

Permeability in this Palms soil is moderately slow. Surface runoff is ponded. Available water capacity is very high. Organic matter content also is very high. Natural fertility is high. The seasonal high water table is within a depth of 1 foot.

Most drained areas of this soil are used for cultivated crops, specialty crops, or hay and pasture. They have fair suitability for these uses. Some areas are undrained and are idle. Tile drainage is needed in cultivated areas. In places, however, the water in the soil contains large amounts of iron oxide, which can clog tile lines. Delaying cultivation until spring reduces soil blowing. The soil is suitable for water-tolerant pasture grasses such as Garrison creeping foxtail or reed canarygrass.

The suitability of this soil for trees and shrubs, mainly water-tolerant species, in windbreaks is poor. Drainage lowers the seasonal high water table and provides a deeper root zone. Completion of site preparation the fall before planting helps to reduce plant competition and soil blowing. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIIw drained and Vw undrained.

631—Oran silt loam, 1 to 4 percent slopes. This soil is nearly level to gently sloping and somewhat poorly drained. It is on ridgetops and side slopes on till plains. The areas of this unit are irregular in shape and range from 3 acres to about 30 acres.

Typically, the surface layer is very dark gray, friable silt loam about 8 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is about 34 inches thick. The upper part of the subsoil is dark grayish brown, friable silt loam; the middle part is grayish brown, mottled, friable loam; and the lower part is dark yellowish brown, friable to firm loam. The underlying material to a depth of about 60 inches is yellowish brown, mottled, firm loam. In places the surface layer is darker and thicker or the subsoil contains more grayish soil.

Included with this soil in mapping are small areas of the well drained Racine soils in similar landscape positions and the poorly drained Tripoli soils in shallow depressions and drainageways. Included soils make up 2 to 10 percent of the map unit.

Permeability in this Oran soil is moderate. Surface runoff is slow. Available water capacity is high. Organic matter content is moderate. Natural fertility is high. The seasonal high water table is 2 to 4 feet below the surface.

Most areas of this soil are used for row crops and are well suited to this use. The common crops are corn and soybeans. The main management concern is water erosion. Conservation tillage and crop residue in and on the soil reduce puddling on and crusting of the soil after heavy rains and reduce water erosion. Tile drainage improves the suitability for crops and the workability in some areas.

The suitability of this soil for trees and shrubs in windbreaks is good. Completion of site preparation in the fall before planting helps to reduce plant competition. In some years working this soil in early spring causes clod formation. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIe.

632—Kensett Variant silt loam. This soil is nearly level and somewhat poorly drained. It is on slightly convex to concave areas of bedrock-controlled uplands. The areas are irregular in shape and range from 3 acres to about 150 acres.

Typically, the surface layer is very dark brown, friable silt loam about 10 inches thick. The subsurface layer is very dark brown, friable silt loam about 3 inches thick. The subsoil is about 11 inches thick. It is dark grayish brown, mottled, friable silty clay loam in the upper part and olive brown, firm clay loam in the lower part. The underlying material to a depth of about 60 inches is yellowish brown and brownish yellow, friable channery silt loam. In places the surface layer is darker and thicker or the subsoil contains more grayish soil.

Included with this soil in mapping are small areas of the well drained Rossfield and Taopi soils on top of low ridges. Included soils make up 5 to 10 percent of the area.

Permeability in this Kensett Variant soil is moderate. Surface runoff is slow. Available water capacity is moderate. Organic matter content and natural fertility are high. The seasonal high water table is at a depth of 2 to 4 feet.

Most areas of this soil are used for row crops. They have fair suitability for this use. The common crops are corn and soybeans. Wetness in the early part of the growing season and droughtiness in the latter part are the main management concerns. Early-maturing crops, such as the small grains, are best suited to this soil because of late-season droughtiness. This soil is well suited to irrigation. Tile drainage improves the suitability for crops, improves workability, and enables the soil to warm up earlier in the spring. Channers in the lower part of the soil interfere with the installation of tile drains.

The suitability of this soil for trees and shrubs, mainly drought-tolerant species, in windbreaks is good. Completion of site preparation in the spring before planting helps to reduce erosion. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIs.

633B—Nordness Variant loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on side slopes and ridgetops of bedrock-controlled uplands. The areas are irregular in shape and range from 3 acres to about 150 acres.

Typically, the surface layer is dark grayish brown, friable loam about 7 inches thick. The subsoil is about 11 inches thick. The upper part of the subsoil is yellowish brown, friable clay loam, and the lower part is dark brown, friable clay loam. The underlying material to a depth of about 60 inches is brownish yellow, friable channery silt loam that is about 25 to 30 percent soft weathered limestone channers. In places the surface layer is darker.

Included with this soil in mapping are small areas of hard limestone bedrock outcroppings on convex parts of side slopes. These inclusions make up 5 to 7 percent of the map unit.

Permeability in this Nordness Variant soil is moderate. Surface runoff is medium. Available water capacity is moderate. Organic matter content is moderately low. Natural fertility is low.

Most areas of this soil are used for row crops and have fair suitability for this use. The common crops are corn, soybeans, oats, and wheat. Early-maturing crops, such as the small grains, are best suited to this soil because of late-season droughtiness. This soil is well suited to irrigation. Conservation tillage and crop residue in and on the soil reduce erosion.

This soil is well suited to grasses and legumes for hay or pasture. Droughtiness is a hazard. Overgrazing reduces plant density and hardiness. Proper stocking and deferment of grazing during summer help to keep pastures in good condition.

The suitability of this soil for trees and shrubs, mainly drought-tolerant species, in windbreaks is fair. Completion of site preparation in the spring before planting helps to reduce erosion. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IVs.

634—Protivin silt loam. This soil is nearly level to gently sloping and somewhat poorly drained. It is on top of low ridges and slight rises on till plains. The areas are irregular in shape and range from 2 acres to about 40 acres.

Typically, the surface layer is black, friable silt loam about 9 inches thick. The subsurface layer is black, friable silt loam about 13 inches thick. The subsoil is about 27 inches thick. It is olive brown, friable clay loam in the upper part and brown, very firm clay loam in the lower part. The underlying material to a depth of about 60 inches is mottled, brown, firm clay loam. In places the subsoil contains more grayish material and the surface layer is thicker. In a few other places the underlying material contains more sand and less clay.

Included with this soil in mapping are small areas of the moderately well drained Hayfield soils and the well drained to moderately well drained Kenyon soils on higher ridgetops and side slopes. Included soils make up 5 to 15 percent of the map unit.

Permeability in this Protivin soil is moderately slow. Surface runoff is medium. Available water capacity is high. Organic matter content and natural fertility also are high. The seasonal high water table is at a depth of 2 to 4 feet.

Most areas of this soil are used for cropland and are well suited to this use. The common crops are corn and soybeans. Tile drainage, mainly by closely spaced lines, improves the suitability for crops and the workability of the soil in some areas. Conservation tillage and crop residue in and on the soil reduce puddling on and crusting of the soil after heavy rains and help to control erosion. Fall tillage improves spring seedbeds because frost action breaks up the clods.

The suitability of this soil for trees and shrubs in windbreaks is good. Completion of site preparation the fall before planting helps to reduce plant competition. In some years tilling this soil in early spring causes clod formation. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIw.

635—Riceville silt loam. This soil is nearly level to gently sloping and somewhat poorly drained. It is on slightly concave to slightly convex areas on till plains. The areas are irregular in shape and range from 3 acres to about 100 acres.

Typically, the surface layer is very dark brown, friable silt loam about 7 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 4 inches thick. The subsoil is about 29 inches thick. The upper part of the subsoil is dark grayish brown and brown, mottled, friable loam; the lower part is yellowish brown, mottled, very firm clay loam. The underlying material to a depth of about 60 inches is yellowish brown, mottled, very firm, calcareous clay loam. In places the surface layer is thicker and the subsoil contains more grayish material. In a few other places the subsoil and underlying material contain less clay.

Included with this soil in mapping are small areas of the moderately well drained Hayfield soils on slight rises and the poorly drained Udolpho soils in slightly concave areas. Both soils formed in outwash material. Included soils make up 5 to 15 percent of the map unit.

Permeability in this Riceville soil is moderately slow. Surface runoff is slow. Available water capacity is high. Organic matter content is moderate. Natural fertility is medium. The seasonal high water table is at a depth of 2 to 4 feet.

Most areas of this soil are used for row crops and are well suited to this use. The common crops are corn and soybeans. Tile drainage, mainly by closely spaced lines, improves the suitability for crops, improves workability, and enables the soil to warm up early in spring. Conservation tillage and crop residue in and on the soil reduce crusting of and puddling on this soil after heavy rains and help reduce water erosion. Fall tillage improves spring seedbeds because frost action breaks up the clods.

The suitability of this soil for trees and shrubs, mainly wetness-tolerant species, in windbreaks is fair to poor. Drainage lowers the seasonal high water table and provides a deeper root zone. Completion of site preparation is needed the fall before planting because in many years this soil is too wet to till in early spring without causing clod formation. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIw.

637—Schley silt loam. This soil is nearly level and somewhat poorly drained. It is on slightly convex and concave areas on till plains. The areas are irregular in shape and range from 3 acres to about 100 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. The subsurface layer is grayish brown, mottled, friable silt loam about 5 inches thick. The subsoil is about 27 inches thick. The upper part of the subsoil is grayish brown, mottled, friable silt loam; the middle part is brown, mottled, friable sandy loam; and the lower part is strong brown, mottled, friable sandy clay loam. The underlying material to a depth of about 60 inches is brown, mottled, firm sandy clay loam. In places the surface layer is thicker and darker and the subsoil contains more grayish material. In a few other places the underlying material contains more sand.

Included with this soil in mapping are small areas of the moderately well drained Hayfield soils on slight rises and the poorly drained Udolpho soils on slightly concave slopes. Included soils make up 5 to 15 percent of the map unit.

Permeability in this Schley soil is moderate. Surface runoff is slow. Available water capacity and organic matter content are high. Natural fertility is medium. The seasonal high water table is at a depth of 1 to 3 feet.

Most areas of this soil are used for row crops and are well suited to this use. The common crops are corn and soybeans. Wetness is the main management concern. Tile drainage improves the suitability for crops, improves workability, and enables the soil to warm up early in spring. Conservation tillage and crop residue in and on the soil reduce puddling on and crusting of the soil after heavy rains and reduce erosion. Fall tillage improves spring seedbeds because frost action breaks up the clods.

The suitability of this soil for trees and shrubs, mainly wetness-tolerant species, in windbreaks is fair. Drainage lowers the seasonal high water table and provides a deeper root zone. Completion of site preparation is needed the fall before planting because in many years this soil is too wet to till in early spring without causing clod formation. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIw.

638B—Taopi silt loam, 1 to 6 percent slopes. This soil is nearly level and gently sloping and is well drained. It is on convex side slopes and ridgetops on bedrock-controlled uplands. The areas are irregular in shape and range from 3 acres to about 150 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 23 inches thick. The upper part of the subsoil is dark brown and yellowish brown, friable loam. The middle part is yellowish brown, friable clay loam. The lower part is very dark grayish brown, very firm clay. The underlying material to a depth of about 60 inches is light gray, very friable, calcareous cobbly silt loam that is 25 to 30 percent hard weathered limestone cobbles. In some areas the underlying material is hard limestone. In some other areas the surface layer and upper part of the subsoil contain more sand.

Included with this soil in mapping are small areas of the well drained Racine soils on ridgetops. Included soils make up about 5 to 8 percent of the unit.

Permeability in this Taopi soil is moderate in the upper part and slow in the substratum. Surface runoff is medium. Available water capacity is moderate. Organic matter content also is moderate. Natural fertility is high.

Most areas of this soil are used for row crops and are well suited to this use. The common crops are corn and soybeans. Early-maturing crops, such as the small grains, are best suited to this soil because of the hazard of late-season droughtiness. This soil is well suited to irrigation. Conservation tillage and crop residue in and on the soil reduce erosion. Contour farming reduces erosion on long slopes.

This soil is well suited to trees and shrubs, mainly drought-tolerant species, in windbreaks and environmental plantings. Completion of site preparation in the spring before planting helps to reduce erosion. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIe.

638C—Taopi silt loam, 6 to 12 percent slopes. This soil is sloping and well drained. It is on convex side slopes and ridgetops on bedrock-controlled uplands. The areas are irregular in shape and range from 3 acres to about 150 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsurface layer is dark brown, friable silt loam about 4 inches thick. The subsoil is about 16 inches thick. The upper part of the subsoil is dark brown, friable loam. The lower part is dark brown, extremely firm clay. The underlying material to a depth of about 60 inches is brownish yellow, friable cobbly silt loam that is 25 to 30 percent soft weathered limestone cobbles. In a few places the surface layer and subsoil are as thin as 12 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Terril soils in drainageways and the well drained Racine soils on ridgetops. Included soils make up about 5 to 8 percent of the unit.

Permeability in this Taopi soil is moderate in the upper part and slow in the substratum. Surface runoff is moderate to rapid. Available water capacity is moderate. Organic matter content also is moderate. Natural fertility is high.

Most areas of this soil are used for row crops and have fair suitability for this use. The common crops are corn and soybeans. Early-maturing crops, such as the small grains, are best suited to this soil because of late-season droughtiness. This soil is well suited to irrigation. Conservation tillage and crop residue in and on the soil reduce erosion. Contour farming reduces erosion on long slopes.

This soil is well suited to trees and shrubs, mainly drought-tolerant species, for windbreaks and environmental plantings. Completion of site preparation in the spring before planting helps to reduce erosion. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIIe.

699A—Rossfield silt loam, 0 to 2 percent slopes. This soil is nearly level and well drained. It is on broad, flat ridgetops on bedrock-controlled uplands. The areas are irregular in shape and range from 3 acres to about 150 acres.

Typically, the surface layer is very dark brown, friable silt loam about 8 inches thick. The subsurface layer is very dark brown, friable silt loam about 7 inches thick. The subsoil is about 14 inches thick. The upper part of the subsoil is brown, friable loam. The lower part is yellowish brown, friable loam. The underlying material to a depth of about 60 inches is brownish yellow, friable channery loam and channery sandy loam that is 20 to 30 percent soft weathered limestone channers.

Included with this soil in mapping are small areas of the somewhat poorly drained Kensett Variant soils in shallow depressions. Included soils make up 2 to 10 percent of the map unit.

Permeability in this Rossfield soil is moderate in the upper part and moderately rapid in the lower part.

Surface runoff is slow. Available water capacity is low to moderate. Organic matter content is moderate. Natural fertility is high.

Most areas of this soil are used for row crops and are well suited to this use. The common crops are corn, soybeans, small grains, and alfalfa. Early-maturing crops, such as the small grains, are best suited to this soil because of late-season droughts. This soil is well suited to irrigation. Crop residue in and on the soil and conservation tillage help to reduce erosion and soil blowing.

The suitability of this soil for trees and shrubs, mainly drought-tolerant species, in windbreaks is good. Completion of site preparation in the spring before planting helps to reduce erosion. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is I.

699B—Rossfield silt loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on side slopes and ridgetops on bedrock-controlled uplands. The areas are irregular in shape and range from 2 acres to about 100 acres.

Typically, the surface layer is very dark brown, friable silt loam about 12 inches thick. The subsoil is about 15 inches thick. The upper part of the subsoil is brown, friable loam. The lower part is yellowish brown, friable loam. The underlying material to a depth of about 60 inches is brownish yellow, friable channery loam and channery sandy loam that is 20 to 30 percent soft weathered limestone channers.

Included with this soil in mapping are small areas of well drained Mottland soils on side slopes. Included soils make up about 5 percent of the unit.

Permeability in this Rossfield soil is moderate in the upper part and moderately rapid in the lower part. Surface runoff is medium. Available water capacity is moderate. Organic matter content also is moderate. Natural fertility is high.

Most of the acreage of this soil is used for cultivated crops and is well suited to this use. The common crops are corn, soybeans, wheat, and oats. Conservation tillage and contour farming reduce erosion on this soil. Early-maturing crops, such as the small grains, are best suited to this soil because of late-season droughtiness.

The suitability of this soil for trees and shrubs, mainly drought-tolerant species, in windbreaks is good. Completion of site preparation in the spring before planting helps to reduce erosion. Shallow cultivation and applications of herbicide help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIe.

1013—Pits, quarry. This unit consists of sites that are mined for limestone. Some of the areas are excavations into bedrock, some are piles of bedrock fragments, and some are under water.

Onsite investigation is needed to determine the potential and limitations of this unit for any use and for reclamation.

This unit is not assigned to a land capability classification.

1030—Udorthents-Pits complex. These areas are or were used for mining sand and gravel. They consist of excavations, stockpiles of sand and gravel, and areas filled with waste or water. The areas range from about 3 to 100 acres and are irregular in shape.

Included with this unit in mapping are borrow pits formed by the removal of loamy earthy materials. Also included are old iron-mine pits.

Some reclaimed areas of this unit are used for commercial, industrial, or residential development. An onsite investigation is needed to determine the potential and limitations of the unit for any use.

This unit is not assigned to a land capability classification.

1078—Udorthents, nearly level to sloping. This unit consists of nearly level to sloping areas where the original soil has been removed or covered with other material. Most of these areas are reclaimed gravel borrow pits. In areas where the soil material has been removed, the remaining material is similar to the subsoil or substratum of adjacent soils. Most areas are rectangular and range from 3 to about 50 acres.

Typically, the upper 60 inches of the unit is variable in composition. In most areas the surface layer is medium textured fill material of variable thickness over coarse textured underlying material. In a few places the surface layer is sandy or the underlying material is medium to fine textured.

Included with this soil in mapping are areas of unreclaimed gravel pits. Also included are a few areas of stockpiled sand, gravel, or loamy material. Included areas make up 2 to 15 percent of the unit.

The permeability, runoff, organic matter content, and available water capacity of these Udorthents are variable. The reaction is typically slightly acid through mildly alkaline. Some areas, particularly the low ones, have a seasonal high water table.

Most areas of this unit are farmed as part of adjoining fields. Some are idle or pastured. The suitability of the unit for farming, trees and shrubs, and building sites varies greatly because of the wide range of soil characteristics. Onsite investigation is needed to determine the potential for any use. Drainage or irrigation is suitable for many areas used for farming. Crop residue in and on the soil and conservation tillage will improve tilth, reduce crusting of the soil after rains, and reduce erosion. Diversions also reduce erosion in some areas.

This unit is not assigned to a land capability classification.

1812—Terril silt loam. This soil is nearly level to gently sloping and moderately well drained. It is in drainageways on till plains and bedrock-controlled uplands. The areas are long and narrow and range from 3 to 40 acres.

Typically, the surface layer is black, friable silt loam about 9 inches thick. The subsurface layer is also black, friable silt loam about 14 inches thick. The next layer is very dark grayish brown, friable loam about 7 inches thick. The subsoil is about 13 inches thick. The upper part of the subsoil is dark brown, friable loam. The lower part is dark brown, friable sandy loam. The underlying material to a depth of about 60 inches is yellowish brown, loose coarse sand. In places the subsoil contains grayish mottles. In other places silty or loamy layers are at a depth of about 50 inches.

Included with this soil in mapping are small areas of the poorly drained Clyde and Marshan soils in drainageways. Included soils make up 5 to 10 percent of the unit.

Permeability in this Terril soil is moderate in the upper part and rapid in the lower part. Surface runoff is medium. Available water capacity is high. Organic matter content and natural fertility also are high.

Most areas of this soil are used for cultivated crops and are well suited to this use. Corn and soybeans are the common crops. Crop residue in and on the soil and conservation tillage help to prevent puddling and crusting during wet periods and reduce erosion. Grassed waterways reduce erosion and gullying in some areas.

The suitability of this soil for trees and shrubs in windbreaks is good. Completion of site preparation the fall before planting helps to control weeds and improve the seedbed for tillage in early spring without causing clod formation. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is I.

1814B—Waucoma silt loam, 1 to 6 percent slopes. This soil is gently sloping and well drained. It is on convex summits and side slopes of ridges on bedrock-controlled uplands. The areas are irregular in shape and range from 2 acres to about 20 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 31 inches thick. It is dark brown and brown, friable silt loam and loam in the upper part and brown, firm silt loam and clay loam in the lower part. The underlying material to a depth of about 60 inches is yellowish brown, friable channery silt loam containing about 20 percent soft weathered limestone channers. In a few places the solum is as shallow as 12 inches.

Included with this soil in mapping are small areas of the poorly drained Faxon Variant soils and the somewhat poorly drained Kensett Variant soils in drainageways and depressions. Also included in similar landscape positions are a few small areas of the well drained Ostrander soils where limestone is at a depth of more than 60 inches. Included soils make up about 10 to 15 percent of the map unit.

Permeability in this Waucoma soil is moderate in the upper part and slow in the lower part. Surface runoff is medium. Available water capacity is high. Organic matter content is moderate. Natural fertility is medium.

Most areas of this soil are used for crops and are well suited to this use. The common crops are corn, soybeans, oats, and wheat. Conservation tillage and contour farming reduce runoff and erosion on this soil.

The suitability of this soil for trees and shrubs, mainly drought-tolerant species, in windbreaks is good. Completion of site preparation in the spring before planting reduces erosion. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIe.

1841—Hayfield loam, loamy substratum. This soil is nearly level and moderately well drained. It is on ridgetops and slight rises on till plains. The areas are irregular in shape and range from 2 acres to about 40 acres.

Typically, the surface layer is very dark grayish brown, friable loam about 7 inches thick. The subsurface layer is dark grayish brown, mottled, friable loam about 6 inches thick. The subsoil is dark brown and brown, mottled, friable loam and sandy loam about 15 inches thick. The upper part of the underlying material is light gray, mottled, loose gravelly coarse sand about 24 inches thick. The remainder of the underlying material to a depth of about 60 inches is grayish brown, mottled, friable loam. In places the loamy substratum material is at a depth of more than 60 inches or the surface layer contains more sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Schley soils in lower areas and the well drained Dowagiac and excessively drained Lilah soils in similar landscape positions. Included soils make up 5 to 15 percent of the map unit.

Permeability in this Hayfield soil is moderate in the upper part and rapid in the underlying material. Surface runoff is slow. Available water capacity is moderate. Organic matter content is moderate. Natural fertility is medium. The seasonal high water table is at a depth of 2.5 to 5.0 feet.

Most areas of this soil are used for row crops and small grains and are well suited to this use. The common crops are corn, soybeans, wheat, and oats. Wetness in early spring and droughtiness during the late growing season are the main management concerns. Early-maturing crops, such as the small grains, are best suited to this soil because of late-season droughtiness. Irrigation improves crop growth on this soil. Tile drainage improves crop growth and workability in some areas. Conservation tillage and delaying tillage until spring reduce erosion and soil blowing.

The suitability of this soil for trees and shrubs, mainly drought-tolerant species, in windbreaks is good. Drainage lowers the seasonal high water table and provides a deeper root zone in the spring and during wet periods. Completion of site preparation in spring before planting reduces plant competition. Shallow cultivation and herbicides help to control weeds in windbreaks.

The land capability classification is IIs.

1844—Atkinson loam. This soil is nearly level and well drained. It is on ridgetops on bedrock-controlled uplands. The areas are irregular in shape and range from 3 to 150 acres.

Typically, the surface layer is very dark brown, friable loam about 8 inches thick. The subsurface layer is very dark brown, friable loam about 4 inches thick. The next layer is dark brown, friable loam about 5 inches thick. The subsoil is about 28 inches thick. The upper part of the subsoil is dark brown, friable sandy clay loam; the middle part is brown and dark yellowish brown, firm clay loam; and the lower part is yellowish brown, firm clay. The underlying material to a depth of about 60 inches is yellowish brown, friable channery silt loam.

Included with this soil in mapping are small areas of the poorly drained Faxon Variant soils and somewhat poorly drained Kensett Variant soils in drainageways and depressions. Also included are areas of the well drained Ostrander soils. Included soils make up 5 to 15 percent of the unit.

Permeability in this Atkinson soil is moderate in the upper part and slow in the lower part. Surface runoff is slow. Available water capacity is moderate. Organic matter content also is moderate. Natural fertility is medium.

Most areas of this soil are used for row crops and are well suited to this use. The common crops are corn, soybeans, small grains, and alfalfa. Early-maturing crops, such as the small grains, are best suited to this soil because of late-season droughts. This soil is well suited to irrigation. Crop residue in and on the soil and conservation tillage will reduce erosion and soil blowing.

The suitability of this soil for trees and shrubs, mainly drought-tolerant species, in windbreaks is good. Completion of site preparation in the spring before planting reduces erosion. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is I.

1884—Stateline silt loam. This soil is nearly level and poorly drained. It is in shallow depressions and on low rises on till plains. The areas are irregular in shape and range from 3 acres to about 100 acres.

Typically, the surface layer is very dark gray, friable silt loam about 7 inches thick. The subsurface layer is dark grayish brown, friable silty clay loam and clay loam about 7 inches thick. The subsoil is about 46 inches thick. The upper part of the subsoil is dark grayish brown and olive gray, mottled, friable silty clay loam and silty clay. The lower part to a depth of about 60 inches is dark gray and grayish brown, mottled, very firm clay. In places the surface layer is thicker and darker and the underlying material contains more sand and less clay. In a few other places a layer of loamy sand as much as 18 inches thick is in the lower part of the subsoil.

Included with this soil in mapping are small areas of the moderately well drained Hayfield soils on crests of low ridges and the somewhat poorly to moderately well drained Donnan soil on slight rises. Included soils make up 5 to 15 percent of the map unit.

Permeability in this Stateline soil is very slow. Surface runoff is slow. Available water capacity is high. Organic matter content is moderate. Natural fertility is medium. The seasonal high water table is within a depth of 3 feet.

Most areas of this soil are used for row crops and have fair suitability for this use. The common crops are corn and soybeans. Tile drainage improves the suitability for crops, improves workability, and enables the soil to warm up earlier in spring. Because of the very slow permeability of this soil, tile lines need to be spaced more closely than in most other soils. Fall tillage improves spring seedbeds because frost action breaks up the clods.

The suitability of this soil for trees and shrubs, mainly wetness-tolerant species, in windbreaks is fair. Drainage lowers the seasonal high water table and provides a deeper root zone. Completion of site preparation is needed the fall before planting because in many years this soil is too wet to till in early spring without causing clod formation. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIIw.

1891—Faxon Variant silty clay loam. This soil is nearly level and poorly drained. It is in plane to slightly concave drainageways and shallow depressions on bedrock-controlled uplands. The areas are irregular in shape and range from 2 acres to about 100 acres.

Typically, the surface layer is black, friable silty clay loam about 10 inches thick. The subsurface layer is very dark gray, friable silty clay loam about 4 inches thick. The subsoil is about 23 inches thick. The upper part of the subsoil is friable silty clay loam. The middle part is olive gray, mottled, friable silt loam. The lower part is grayish brown, mottled, friable clay loam. The underlying material to a depth of about 60 inches is yellowish brown, friable channery silt loam that is about 20 percent soft weathered limestone channers. In places the surface layer is thinner and lighter colored.

Included with this soil in mapping are small areas of the poorly drained Clyde and Marshan soils and the very poorly drained Shandep soils in drainageways. Included soils make up 2 to 10 percent of the unit.

Permeability in this Faxon Variant soil is moderate. Surface runoff is slow. Available water capacity is moderate. Organic matter content is very high. Natural fertility is high. The seasonal high water table is at a depth of 1 to 3 feet.

Most areas of this soil are drained and used for row crops. They have fair suitability for this use. The common crops are corn, soybeans, wheat, and oats. Tile drainage improves the suitability for crops, improves workability, and allows the soil to warm up early in spring. Fall tillage improves spring seedbeds because frost action breaks up the clods.

The suitability of this soil for trees and shrubs, mainly wetness-tolerant species, in windbreaks is fair. Drainage lowers the seasonal high water table and provides a deeper root zone. Completion of site preparation is needed the fall before planting to reduce plant competition and because in many years this soil is too wet to till early in spring. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIIw.

1903—Udolpho silt loam, loamy substratum, swales. This soil is nearly level and poorly drained. It is in slightly concave to plane shallow depressions and drainageways on gently sloping uplands and on outwash plains. This soil is subject to ponding. The areas are irregular in shape and range from 2 acres to about 60 acres.

Typically, the surface layer is very dark grayish brown, very friable silt loam about 10 inches thick. The subsurface layer is dark grayish brown, very friable silt loam about 4 inches thick. The subsoil is about 16 inches thick. It is grayish brown, mottled, friable loam. The upper part of the underlying material is grayish brown, mottled gravelly coarse sand about 18 inches thick. The lower part of the underlying material to a depth of about 60 inches is grayish brown, mottled, firm loam. In places the loamy substratum material is at a depth of more than 60 inches. In a few other places the surface layer is thicker and darker and the subsoil contains more grayish material.

Included with this soil in mapping are small areas of the well drained Dowagiac soils and the moderately well drained Hayfield soils on low ridges. Included soils make up 2 to 12 percent of the map unit.

Permeability in this Udolpho soil is moderate in the upper part and rapid in the underlying material. Surface runoff is slow or ponded. Available water capacity is moderate. Organic matter content also is moderate. Natural fertility is medium. The seasonal high water table is within a depth of 2 feet.

Most areas of this soil are used for row crops and small grains. They have fair suitability for this use. The common crops are corn, soybeans, wheat, and oats. Tile drainage improves the suitability for crops, improves workability, and allows the soil to warm up early in spring.

The suitability of this soil for trees and shrubs, mainly wetness-tolerant species, in windbreaks is good. Drainage lowers the seasonal high water table and provides a deeper root zone in the spring and during wet periods. Completion of site preparation before planting reduces plant competition. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIIw.

1904—Udolpho silt loam, loamy substratum. This soil is nearly level and poorly drained. It is on low convex rises on outwash plains and stream terraces. The areas are irregular in shape and range from 2 acres to about 60 acres.

Typically, the surface layer is very dark grayish brown, very friable silt loam about 8 inches thick. The subsurface layer is mottled, grayish brown silt loam about 5 inches thick. The subsoil is grayish brown, mottled, friable loam about 27 inches thick. The upper part of the underlying material is grayish brown and light olive brown, mottled, loose gravelly coarse sand about 24 inches thick. The lower part of the underlying material to a depth of about 60 inches is grayish brown, mottled, firm loam. In places the loamy substratum is at a depth of more than 60 inches. In a few other places the surface layer is thicker and darker or contains more sand.

Included with this soil in mapping are small areas of the well drained Dowagiac soils and the moderately well drained Hayfield soils on small knolls and adjacent side slopes. Included soils make up 2 to 12 percent of the map unit.

Permeability in this Udolpho soil is moderate in the upper part and rapid in the underlying material. Surface runoff is slow. Available water capacity is moderate. Organic matter content is moderate. Natural fertility is medium. The seasonal high water table is at a depth of 1 to 3 feet.

Most areas of this soil are used for row crops and small grains and are well suited to this use. The common crops are corn, soybeans, wheat, and oats. Tile drainage improves the suitability for crops, improves workability, and allows the soil to warm up early in spring. Conservation tillage and crop residue in and on the soil reduce puddling on and crusting of the soil after heavy rains and reduce erosion and soil blowing.

The suitability of this soil for trees and shrubs, mainly wetness-tolerant species, in windbreaks is good. Drainage lowers the seasonal high water table and provides a deeper root zone in the spring and during wet periods. Completion of site preparation before planting reduces plant competition. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIw.

1905—Brownsdale silt loam. This soil is nearly level and poorly drained. It is on till plains. The areas are on slightly concave foot slopes and in drainageways and range from 3 acres to about 100 acres.

Typically, the surface layer is black, friable silt loam about 9 inches thick. The subsurface layer is dark gray, mottled, friable silt loam about 4 inches thick. The subsoil is about 35 inches thick. The upper part of the subsoil is gray, mottled, friable silty clay loam. The middle part is olive gray, mottled, friable loam. The lower part is olive gray and gray, mottled, firm loam. The underlying material to a depth of about 60 inches is grayish brown, mottled, firm loam.

Included with this soil in mapping are small areas of the poorly drained Tripoli soils in drainageways and the somewhat poorly drained Sargeant soils on slightly convex rises. Included soils make up 5 to 15 percent of the map unit.

Permeability in this Brownsdale soil is moderately slow. Surface runoff is slow. Available water capacity is high. Organic matter content is moderate. Natural fertility is medium. The seasonal high water table is within a depth of 3 feet.

Most areas of this soil are used for cultivated crops. They have fair suitability for this use. The common crops are corn and soybeans. Wetness is the main management concern. Tile drainage improves the suitability for crops, improves workability, and allows the soil to warm up early in spring. Because of the permeability, shallow surface ditches and closely spaced tile drains are suitable. Conservation tillage and crop residue in and on the soil reduce erosion and prevent puddling on and crusting of the surface after heavy rains. Fall tillage improves spring seedbeds because frost action breaks up the clods.

The suitability of this soil for trees and shrubs, mainly wetness-tolerant species, in windbreaks is fair. Drainage lowers the seasonal high water table and provides a deeper root zone. Completion of site preparation is needed the fall before planting because in many years this soil is too wet to work early in spring without causing clod formation. Shallow cultivation and herbicides help to control weeds and grasses in newly established windbreaks.

The land capability classification is IIIw.

1974—Coland-Spillville loams, frequently flooded. This unit consists of nearly level, poorly drained and moderately well drained soils on flood plains. The

Coland soils are in backwater areas and depressions in drainageways. The Spillville soils are on slightly higher natural levees. The areas of these soils are long and narrow and range from 5 to 70 acres. They are about 50 percent Coland soils, 30 percent Spillville soils, and 20 percent other soils. The areas were mapped together because they were too small to map separately. Both soils are subject to frequent flooding.

Typically, the surface layer of the Coland soils is black, friable loam about 10 inches thick. The subsurface layer is about 30 inches thick. It is black, friable silty clay loam in the upper part and black, friable clay loam in the lower part. The subsoil is about 15 inches thick. It is very dark gray, friable silty clay loam in the upper part and gray, mottled, friable silty clay loam in the lower part. The underlying material to a depth of about 60 inches is dark gray, friable clay loam. In some areas thin strata of sand, loamy sand, or gravelly loam are in the underlying material.

Typically, the surface layer of the Spillville soils is about 52 inches thick. It is very dark brown, friable loam in the upper part; black, friable loam in the middle part; and very dark grayish brown, friable loam in the lower part. The underlying material to a depth of about 60 inches is very dark brown, friable sandy loam.

Included with this unit in mapping are small areas of the poorly drained and very poorly drained Kalmarville soils in old stream channels and the very poorly drained Shandep soils at the upper reaches of drainageways.

Permeability is moderate in these Coland and Spillville soils. Surface runoff is slow. Available water capacity is high. Organic matter content and natural fertility also are high. The seasonal high water table is at a depth of 1 to 3 feet in the Coland soils and 3 to 5 feet in the Spillville soils.

Most areas of these soils are idle or are in pasture. They are poorly suited or generally unsuited to cultivated crops because of the frequent flooding.

Native bluegrass is the main species in pastures, but water-tolerant grasses and sedges are common in wetter areas. The Coland soils are usually soft, and hummocks form if the soils are grazed when wet. The main management practices are applying lime and fertilizer, using surface drainage on some areas, controlling grazing and weeds, and using water-tolerant grasses such as reed canarygrass and Garrison creeping foxtail, which can also be managed for hay.

Trees and shrubs selected for windbreaks and environmental plantings on Coland soils should be tolerant of wetness. Seedling mortality is moderate because of wetness, and spring planting is delayed in some years. The Spillville soils are suitable for a wide variety of trees and shrubs for windbreaks and environmental plantings. Cultivation or herbicides will help remove competing vegetation on either soil.

The land capability classification is Vw for the Coland and Spillville soils.

1992—Sargeant Variant silt loam. This soil is nearly level and somewhat poorly drained. It is on low rises on bedrock-controlled uplands. The areas are irregular in shape and range from 3 to 50 acres.

Typically, the surface layer is a very dark brown, firm silt loam about 9 inches thick. The subsurface layer is dark grayish brown, mottled, friable silt loam about 5 inches thick. The subsoil is about 26 inches thick. The upper part of the subsoil is grayish brown, mottled, friable loam and clay loam. The middle part is brown, mottled, friable sandy clay loam. The lower part is yellowish brown, extremely firm clay. The underlying material to a depth of about 60 inches is yellowish brown, extremely firm clay. In places the underlying material is soft limestone or siltstone.

Included with this soil in mapping are small areas of the poorly drained Faxon Variant soils in drainageways. Included soils make up 5 to 15 percent of this unit.

Permeability in this Sargeant Variant soil is moderate or moderately low in the upper part and very slow in the lower part. Surface runoff is slow. Available water capacity is high. Organic matter content is moderate. Natural fertility is medium. The seasonal high water table is at a depth of 1 to 3 feet.

Most areas of this soil are used for cultivated crops. Suitability for crops is fair. The common crops are corn and soybeans. Cloddiness of the surface layer is common if this soil is worked when it is wet. Subsurface drainage improves crop growth, improves workability, and allows the soil to warm up early in spring. Because of the very slow permeability in the lower part of the subsoil, closely spaced tile drainage and cross-slope drainage are suitable. Conservation tillage, ridge tillage, and crop residue in and on the soil help reduce erosion and prevent puddling on or crusting of the surface after heavy rains.

The suitability of this soil for trees and shrubs, mainly wetness- and acid-tolerant species, in windbreaks is fair. Completion of site preparation is needed in the fall before planting because in many years this soil is too wet to work in early spring. Shallow cultivation and herbicides help to control weeds in windbreaks.

The land capability classification is IIIw.

Prime Farmland

Prime farmland is one of several kinds of important farmlands defined by the U.S. Department of Agriculture. Identification of prime farmland is a major step in meeting the Nation's needs for food and fiber.

The U.S. Department of Agriculture defines prime farmland as the land that is best suited to producing food, feed, forage, fiber, and oilseed crops. It has the soil quality, growing season, and moisture supply needed to produce a sustained high yield of crops while using acceptable farming methods. Prime farmland produces the highest yields and requires minimal amounts of energy and economic resources, and farming it results in the least damage to the environment.

An area identified as prime farmland must be used for producing food or fiber or must be available for those uses. Thus, urban and built-up land and water areas are not classified as prime farmland.

The general criteria for prime farmland are as follows: a generally adequate and dependable supply of moisture from precipitation or irrigation, favorable temperature and growing-season length, acceptable levels of acidity or alkalinity, few or no rocks, and permeability to air and water. Prime farmland is not excessively erodible, is not saturated with water for long periods, and is not flooded during the growing season. The slope range is mainly from 0 to 6 percent. For more detailed information on the criteria for prime farmland, consult the local staff of the Soil Conservation Service.

The survey area contains about 386,000 acres of prime farmland. That acreage makes up about 86 percent of the total acreage in the survey area and is throughout the county. Crops, mainly corn and soybeans, cover about 360,000 acres of the prime farmland.

The soil map units that make up prime farmland in the survey area are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4, and the location of each unit is shown on the detailed soil maps at the back of this publication. The soil properties and characteristics that affect use and management of the units are described in the section "Detailed Soil Map Units."

Some soils in table 5 are classified as prime farmland if certain limitations or hazards of the soil are overcome. The measures needed to overcome the limitations or hazards of such soils are given in parentheses after the name of the map unit.

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Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm or sandy soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

The 1978 Census of Agriculture lists nearly 390,000 acres in the survey area used for crops and pasture. Of that, 23,055 acres was used for pasture; 284,787 acres for row crops, mainly corn and soybeans; 24,475 acres for small grains, mainly wheat and oats; 23,675 acres for hay; and 33,786 acres for other crops. The acreage in crops and pasture, however, has gradually been decreasing as more and more land is used for urban development.

Water erosion and soil blowing are concerns on nearly all of the cropland, particularly on the Blooming, Ostrander, and Racine soils. Loss of the surface layer through water erosion and soil blowing is damaging to productivity as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Erosion also reduces productivity on soils that tend to be droughty, such as Dickinson and Lilah soils.

Erosion-control practices, which can be used on almost all soils in the county, provide a protective surface cover, reduce runoff, and increase infiltration of air and water. A cropping system that keeps plant cover on the soil for extended periods can hold soil erosion to a minimum and maintain the productive capacity of the soils. On livestock farms, which require pasture and hay, legume and grass forage crops in the cropping system reduce erosion on sloping land and provide organic matter and improve tilth. Conservation tillage practices that leave part or all of the previous crop residue on the surface help to increase infiltration and reduce the hazards of excess runoff and erosion.

Terraces help reduce the length of slope and reduce runoff and water erosion. They are most practical on soils that have smooth, uniform slopes, for example, Readlyn and Oran soils.

Soil blowing is a hazard on the Billett, Dickinson, Dowagiac, and Palms soils. It causes severe damage to these soils if winds are strong and the soils are dry, smooth, and unprotected. Using plant cover or mulch or roughing the surface through conservation tillage will help prevent soil blowing. Windbreaks consisting of suitable trees and shrubs are effective for reducing soil blowing in some areas.

Information on the design of erosion control practices for each kind of soil is contained in the Technical Guide, available in local offices of the Soil Conservation Service.

Soil drainage is the major management need on over half of the land used for crops and pasture in the survey area. Some soils are so wet that crop production is impractical unless they are artificially drained. Crops on the Riceville, Havana, Sargeant, Schley, Skyberg, and Udolpho soils, for example, are damaged in most years if drainage is not used.

The design of drainage systems varies with the kind of soil. A combination of surface and subsurface drains is needed in most areas of poorly drained and very poorly drained soils used for intensive row cropping. Drains have to be more closely spaced in soils that are slowly permeable, such as the Skyberg, Sargeant, Tripoli, and Riceville soils. Finding adequate outlets for tile drainage systems is difficult in many areas of Maxcreek, Mayer, Marshan, and Canisteo soils.

Organic soils subside when they are drained; therefore, special systems are needed to control the depth and timing of drainage in those soils. Maintaining the water table at the level required by crops during the growing season and raising it to the surface during other parts of the year minimizes the subsidence of organic soils.

Soil fertility is variable within the survey area. Many upland soils are naturally quite acid and require applications of ground limestone to raise the pH to a level suitable for alfalfa and other crops that require a neutral soil. The proper types and amounts of lime and fertilizer are based on the results of soil tests, the need of the crop, and the expected yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime to apply.

Soil tilth helps in the germination of seeds and in the infiltration of water into the soil. Soils that are porous have good tilth.

Some soils used for crops in the survey area have poor tilth, or weak soil structure. These soils have a surface layer of silt loam that is light in color and low in content of organic matter. Heavy rainfall causes the subsequent formation of a hard, dry crust on the surface of such soils. This crust prevents infiltration and causes increased runoff. Conservation tillage and regular additions of crop residue and manure help to improve soil structure and to reduce crust formation.

Fall tillage is commonly used on many soils in the county to produce a smooth, clod-free seedbed at planting time in the spring. Unless adequate amounts of crop residue are maintained on the surface, however, soil erosion can be severe.

Fall tillage of cornstalk residue with a chisel plow will leave a rough surface and some cover to control runoff and soil blowing. Performing the tillage on the contour of sloping soils helps to prevent further erosion. The ridge-plant system for row crop production eliminates the need for fall tillage but still provides a warm, moist seedbed at planting time. An adequate drainage system is needed on poorly drained soils, regardless of the tillage method used.

The common small grain in the county is oats.

Special crops grown commercially in the survey area are vegetables and nursery plants and small quantities of sweetcorn.

Pastures in the county generally benefit from controlled grazing, fertilizing, and brush and weed control, and some need renovation. Cool-season species such as alfalfa, birdsfoot trefoil, smooth bromegrass, orchardgrass, timothy, reed canarygrass, and creeping foxtail are well suited to most of the soils. Warm-season grasses provide high forage yields during July and August; the suitable species for most of the soils are switchgrass, big bluestem, and Indiangrass. Little bluestem and sideoats grama are well suited to the droughty soils.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland or for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. The levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-6.

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observations of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from the local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

The main public recreation area in the county is Lake Louise State Park, in the southeast corner of the county near LeRoy. The Minnesota Department of Natural Resources manages five wildlife areas, totaling 550 acres, for public hunting and nature study.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

The common types of wildlife in the county are cottontail rabbits, squirrels, foxes, raccoons, and deer. Ducks, geese, herons, muskrats, and a few mink live near the shallow lakes and a few wildlife-management areas. A change in farming patterns from diversified to continuous row cropping has caused a decrease in the once-abundant habitat for pheasants and a resulting decline in their population.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, soybeans, and oats.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are tall fescue, orchardgrass, and clover.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are goldenrod, bluestem, and wheatgrass.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, dogwood, and hickory. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of

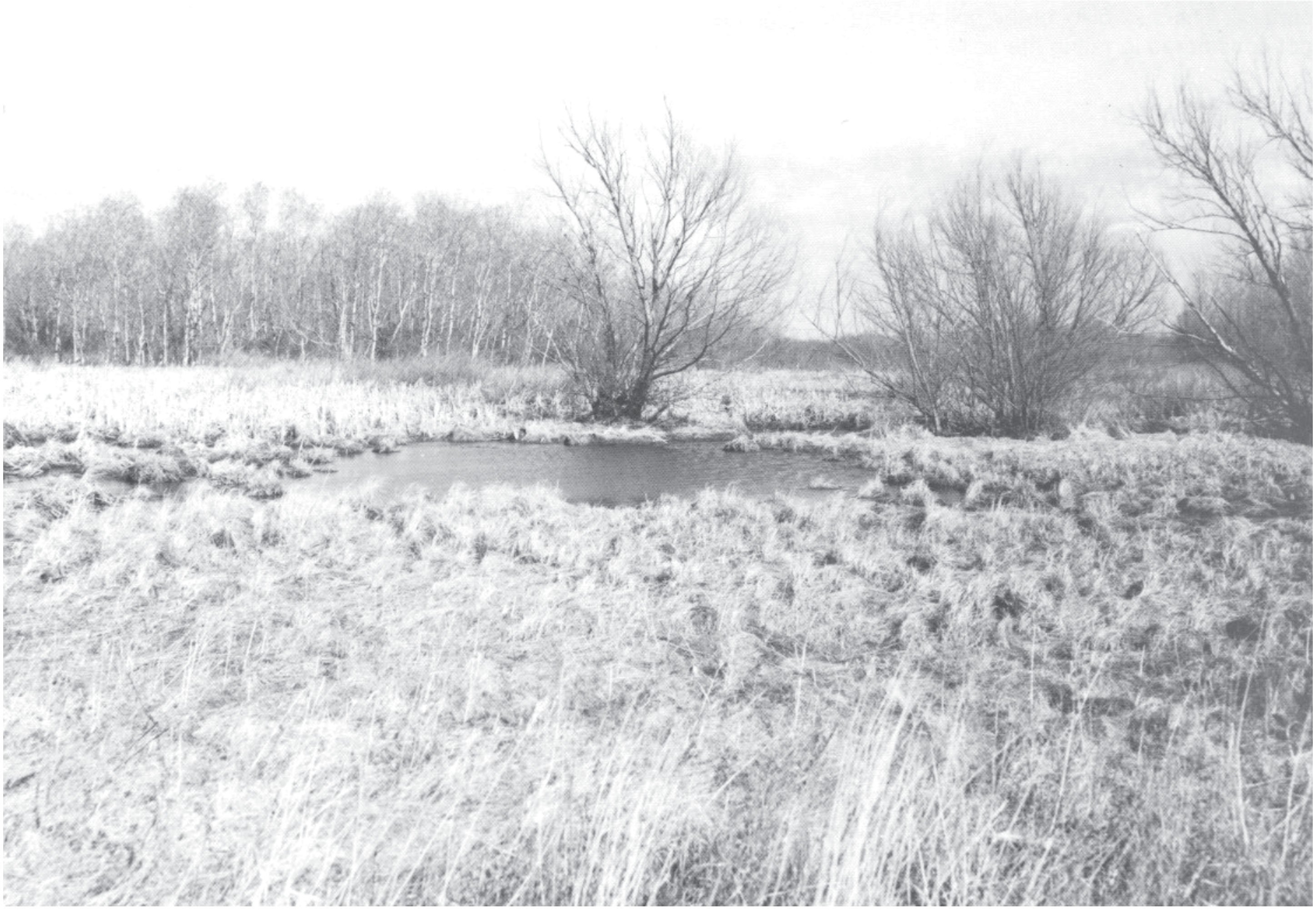

Figure 6.—An area of Palms muck used as wetland wildlife habitat.

shallow water areas are marshes, swamps, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include partridge, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas (fig. 6). Some of the wildlife attracted to such areas are ducks, geese, herons, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost-action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a fragipan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a fragipan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, sandy layers, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a fragipan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by soil texture, depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 7). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

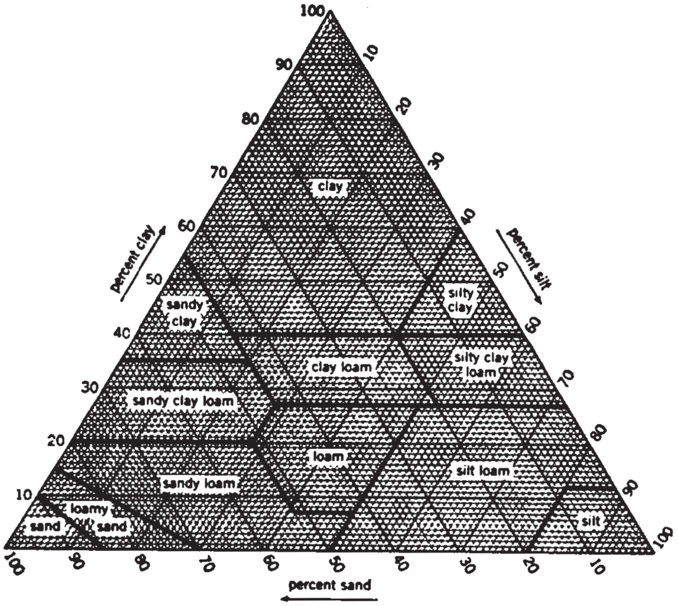

Figure 7.—Percentages of clay, silt, and sand in the basic soil textural classes.

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓ bar moisture tension. Weight is determined after drying the soil at 105° C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous, loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 20 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 20 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary covering of the soil surface by flowing water, is caused by overflowing streams, by runoff from adjacent slopes, or by inflow from high tides. Shallow water standing or flowing for short periods after rainfall or snowmelt is not considered flooding. Standing water in swamps and marshes or in a closed depression is considered ponding.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely to occur.

Frequency, duration, and probable period of occurrence are estimated. Frequency generally is expressed as *none, rare, occasional, common,* or *frequent*. *None* means that flooding is not probable. *Rare* means that flooding is unlikely but possible under unusual weather conditions (there is a near 0 to 5 percent chance of flooding in any year). *Occasional* means that flooding occurs infrequently under normal weather conditions (there is a 5 to 50 percent chance of flooding in any year). *Frequent* means that flooding occurs often under normal weather conditions (there is more than a 50 percent chance of flooding in any year). *Common* is used when classification as occasional or frequent does not affect interpretations. Duration is expressed as *very brief* (less than 2 days), *brief* (2 to 7 days), *long* (7 days to 1 month), and *very long* (more than 1 month). The time of year that floods are most likely to occur is expressed in months. November-May, for example, means that flooding can occur during the period November through May. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information on flooding is based on evidence in the soil profile, namely, thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons, which are characteristic of soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely, grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table, that is, *perched, artesian,* or *apparent;* and the months of the year that the water table commonly is highest. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An *artesian* water table is under hydrostatic head, generally below an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

The two numbers in the "High water table—Depth" column indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. "More than 6.0" indicates that the water table is below a depth of 6 feet or that it is within a depth of 6 feet for less than a month.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence results from either dessication and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. Table 16 shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which usually is a result of oxidation.

Not shown in the table is subsidence caused by an imposed surface load or by withdrawal of the ground water throughout an extensive area as a result of lowering the water table.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of aggregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when the moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

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Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(7)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 17 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquoll (*Aqu*, meaning water, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplaquolls (*Hapl*, meaning minimal horizonation, plus *aquoll*, the suborder of the Mollisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplaquolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, mesic Typic Haplaquolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual (6)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (7)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Ankeny Series

The Ankeny series consists of well drained, moderately rapidly permeable soils on stream terraces. The soils formed in alluvial sediments along the Red Cedar River. Slopes range from 0 to 2 percent.

Typical pedon of Ankeny fine sandy loam, in Lyle Township, 2,500 feet east and 1,200 feet south of the northwest corner of sec. 28, T. 101 N., R. 18 W.

A1—0 to 8 inches; very dark gray (10YR 3/1) fine sandy loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; very friable; neutral; abrupt smooth boundary.

A2—8 to 12 inches; black (10YR 2/1) fine sandy loam; weak very fine granular structure; very friable; neutral; clear wavy boundary.

A3—12 to 24 inches; very dark gray (10YR 3/1) fine sandy loam; weak very fine granular structure; very friable; neutral; gradual wavy boundary.

AB—24 to 30 inches; very dark grayish brown (10YR 3/2) fine sandy loam; weak fine subangular blocky structure; very friable; neutral; clear wavy boundary.

Bw1—30 to 40 inches; brown (10YR 4/3) fine sandy loam; weak medium subangular blocky structure; very friable; many very dark grayish brown (10YR 3/2) organic coatings on surface of peds; neutral; clear wavy boundary.

Bw2—40 to 54 inches; brown (10YR 4/3) fine sandy loam; weak fine and coarse subangular blocky structure; very friable; neutral; gradual wavy boundary.

C—54 to 60 inches; brown (10YR 4/3) fine sandy loam; massive; very friable; neutral.

The thickness of the solum ranges from 45 to 60 inches. The mollic epipedon is 24 to 36 inches thick.

The A horizon has chroma of 1 or 2. It is typically fine sandy loam, but in some pedons it is very fine sandy loam.

The Bw horizon has chroma of 3 or 4.

The C horizon has value of 4 or 5. The C horizon typically is fine sandy loam but ranges to loamy fine sand, fine sand, or sand.

Atkinson Series

The Atkinson series consists of well drained soils on bedrock-controlled uplands. Permeability is moderate in the upper part of the solum and slow in the lower part. The soils formed in glacial drift and a thin layer of residuum over soft weathered limestone. Slopes range from 0 to 2 percent.

The Atkinson soils in this county are outside the defined range of the Atkinson series because of the soft weathered limestone in the 3C horizon. This difference does not significantly affect use and management.

Typical pedon of Atkinson loam, in Racine Township, 2,200 feet north and 75 feet west of the southeast corner of sec. 36, T. 104 N., R. 14 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak coarse subangular blocky structure; friable; neutral; abrupt smooth boundary.

A—8 to 12 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; neutral; clear wavy boundary.

AB—12 to 17 inches; dark brown (10YR 3/2) loam; weak moderate subangular blocky structure; friable; neutral; clear wavy boundary.

Bt1—17 to 25 inches; dark brown (10YR 4/3) sandy clay loam; moderate medium subangular blocky structure; friable; few distinct clay films on faces of peds; slightly acid; clear wavy boundary.

Bt2—25 to 35 inches; brown (10YR 4/3) clay loam; weak medium prismatic structure parting to moderate medium subangular blocky; firm; common distinct clay films on faces of peds; slightly acid; clear wavy boundary.

Bt3—35 to 43 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common distinct clay films on faces of peds; neutral; clear smooth boundary.

2Bt4—43 to 45 inches; yellowish brown (10YR 5/4) clay; massive; very firm; common distinct clay films on faces of peds; neutral; abrupt smooth boundary.

3C—45 to 60 inches; yellowish brown (10YR 5/6) channery silt loam; massive; friable; about 20 percent soft weathered limestone channers; strong effervescence; mildly alkaline.

The solum thickness and depth to soft weathered limestone mainly range from 40 to 50 inches but range to about 55 inches in some pedons. Some pedons contain 2 to 6 percent coarse fragments of mixed lithology.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The texture is loam or silt loam.

The Bt horizon has value of 4 or 5. The texture of the upper part of the Bt horizon is loam, sandy clay loam, or clay loam.

The 3C horizon has hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 4 to 8. It is the channery analogs of silt loam, loam, fine sandy loam, or sandy loam. The 3C horizon consists of 15 to 35 percent channery fragments or soft weathered limestone pebbles.

Billett Series

The Billett series consists of well drained soils on outwash plains and stream terraces. Permeability is moderately rapid in the subsoil and rapid in the underlying material. The soils formed in loamy sediments and sandy underlying material. Slopes range from 2 to 6 percent.

Typical pedon of Billett fine sandy loam, 2 to 6 percent slopes, in Austin Township, 2,000 feet west and 50 feet north of the southeast corner of sec. 10, T. 102 N., R. 18 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak very fine granular structure; very friable; neutral; abrupt wavy boundary.

E—7 to 10 inches; dark grayish brown (10YR 4/2) sandy loam; grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; very friable; medium acid; abrupt wavy boundary.

Bt—10 to 24 inches; brown (10YR 5/3) sandy loam; weak fine subangular blocky structure; very friable; common faint clay films on faces of peds; medium acid; abrupt wavy boundary.

BC—24 to 36 inches; brown (10YR 5/3) loamy fine sand; weak coarse subangular blocky structure; very friable; common faint clay films on faces of peds; medium acid; abrupt wavy boundary.

C1—36 to 40 inches; yellowish brown (10YR 5/6) loamy fine sand; single grained; loose; medium acid; abrupt wavy boundary.

C2—40 to 60 inches; yellowish brown (10YR 5/6) sand; single grained; loose; medium acid.

The thickness of the solum ranges from 30 to 60 inches.

The A horizon has value and chroma of 2 or 3. It is fine sandy loam or loam.

An E horizon has value of 4 or 5 and chroma of 2 or 3. Some pedons do not have an E horizon.

The Bt horizon has value of 4 or 5 and chroma of 3 to 6. It is sandy loam or loamy fine sand or, in places, sandy clay loam or loam.

The C horizon is sand, loamy fine sand, or loamy sand. It has a value of 4 or 5 and chroma of 4 to 6.

Blooming Series

The Blooming series consists of well drained, moderately permeable soils on moraines. These soils formed in silty sediments and the underlying friable loamy till. Slopes range from 2 to 15 percent.

Typical pedon of Blooming silt loam, 2 to 6 percent slopes, in Lansing Township, 1,960 feet north and 2,450 feet east of the southwest corner of sec. 32, T. 103 N., R. 18 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

BE—8 to 13 inches; dark brown (10YR 4/3) silt loam; moderate very fine subangular blocky structure; friable; mixings of very dark grayish brown (10YR 3/2); slightly acid; abrupt wavy boundary.

Bt1—13 to 21 inches; dark brown (10YR 4/3) silty clay loam; moderate very fine subangular blocky structure; friable; few sand and silt grains on faces of peds; few faint clay films on faces of peds; medium acid; abrupt wavy boundary.

2Bt2—21 to 27 inches; yellowish brown (10YR 5/4) loam; weak to moderate fine subangular blocky structure; friable; common distinct brown (10YR 5/3) clay films on faces of peds; 3 percent gravel; few sand and silt grains on faces of peds; medium acid; clear wavy boundary.

2Bt3—27 to 38 inches; light olive brown (2.5Y 5/4) loam; moderate fine and medium prismatic structure; friable; 3 percent gravel; many distinct grayish brown (10YR 5/2) sand and silt coatings on faces of peds; few old root channels filled with clay; medium acid; abrupt wavy boundary.

2Bt4—38 to 45 inches; light olive brown (2.5Y 5/4) loam; weak coarse prismatic structure; friable; 3 percent gravel; few distinct grayish brown (10YR 5/2) sand and silt coatings on faces of peds; medium acid; clear wavy boundary.

2C—45 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; 3 percent gravel; slight effervescence; mildly alkaline.

The thickness of the solum and depth to free carbonates range from 35 to 60 inches. The thickness of the silty sediments ranges from 14 to 24 inches. The coarse fragment content ranges from 0 to 2 percent in the upper, silty sediments and 2 to 6 percent in the lower, loamy layers.

The A horizon has value of 2 or 3 and chroma of 1 or 2.

Some pedons have an E horizon that has value of 3 or 4 and is up to 4 inches thick.

The upper part of the Bt horizon has value of 4 or 5 and chroma of 3 or 4. It is silty clay loam or silt loam.

The 2Bt horizon is dominantly clay loam or loam. In some pedons the upper part of the 2Bt horizon is sandy loam or coarser textured material as much as 5 inches thick. The 2Bt horizon has value of 4 or 5, and chroma of 3 to 5.

The 2C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 4 to 6.

Brownsdale Series

The Brownsdale series consists of poorly drained, moderately slowly permeable soils on till plains. These soils formed in silty sediments and the underlying firm loamy till. Slopes range from 0 to 2 percent.

Typical pedon of Brownsdale silt loam, in Udolpho Township, 1,340 feet north and 60 feet west of the southeast corner of sec. 4, T. 104 N., R. 18 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, gray (10YR 5/1) dry; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

E—9 to 13 inches; dark gray (10YR 4/1) silt loam, light gray (10YR 6/1) dry; many fine faint dark grayish brown (2.5Y 4/2) mottles; moderate medium platy structure; friable; strongly acid; clear wavy boundary.

Btg1—13 to 17 inches; gray (10YR 5/1) and dark grayish brown (2.5Y 4/2) silty clay loam; many fine faint dark grayish brown (2.5Y 4/2) mottles; moderate medium subangular blocky structure; friable; many distinct clean sand and silt grains on faces of peds; few faint clay films on faces of peds; very strongly acid; clear wavy boundary.

Btg2—17 to 26 inches; olive gray (5Y 5/2) silty clay loam; many fine prominent yellowish brown (10YR 5/4) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; friable; many distinct clean sand and silt grains coating faces of peds; common distinct clay films on faces of peds; very strongly acid; clear wavy boundary.

2Btg3—26 to 36 inches; olive gray (5Y 5/2) loam; common coarse prominent yellowish brown (10YR 5/4) mottles; moderate coarse prismatic structure parting to moderate medium subangular blocky; firm; many distinct clean sand and silt grains coating faces of peds; common distinct clay films on faces of peds; 4 percent gravel; strongly acid; clear wavy boundary.

2Btg4—36 to 48 inches; gray (10YR 5/1) loam; common coarse faint grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; many distinct clean sand and silt grains coating faces of peds; few faint clay films on faces of peds; 4 percent gravel; slightly acid; clear wavy boundary.

2Cg—48 to 60 inches; grayish brown (10YR 5/2) loam; common fine prominent light olive brown (2.5YR 5/4) mottles; massive; firm; 4 percent gravel; mildly alkaline.

The thickness of the solum ranges from 40 inches to about 70 inches, and the depth to free carbonates ranges from 50 inches to about 80 inches. The silty sediment is 16 to 30 inches thick. The loamy sediments typically have no coarse fragments, but the lower part in some pedons has a few. The till has 2 to 10 percent coarse fragments.

The A horizon has chroma of 1 or 2. It is loam, silty clay loam, or silt loam.

The E horizon has value of 3 to 5 and chroma mainly of 1 or 2. Some pedons have higher chroma mottles. This horizon is loam, silt loam, or silty clay loam.

The Btg horizon has hue of 10YR to 5Y and value of 3 to 6. It is typically silty clay loam but ranges to loam or clay loam.

The 2Btg horizon has value of 4 to 6. It is loam, sandy clay loam, or clay loam. Coatings of silt or very fine sand are not in all pedons.

The 2C horizon has hue of 2.5Y or 10YR, value of 4 to 6, and chroma mainly of 1 to 3. In some pedons it contains high- or low-chroma mottles. It is loam or sandy clay loam.

Canisteo Series

The Canisteo series consists of poorly drained, moderately permeable soils on moraines. These soils formed in silty sediments and in underlying friable loamy till. Slopes range from 0 to 2 percent.

Typical pedon of Canisteo silty clay loam, in Udolpho Township, 1,400 feet west and 700 feet north of the southeast corner of sec. 6, T. 104 N., R. 18 W.

Ap—0 to 9 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; cloddy; friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

A—9 to 15 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; weak fine to medium subangular blocky structure; friable; strong effervescence; mildly alkaline; clear wavy boundary.

AB—15 to 22 inches; very dark gray (5Y 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; strong effervescence; mildly alkaline; clear wavy boundary.

Bg1—22 to 27 inches; olive gray (5Y 5/2) silt loam; many fine distinct dark grayish brown (2.5Y 4/2) mottles; weak fine and medium subangular blocky structure; friable; slight effervescence; mildly alkaline; clear wavy boundary.

2Bg2—27 to 36 inches; olive gray (5Y 5/2) loam; few medium prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very friable; 3 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

2Cg—36 to 60 inches; olive gray (5Y 5/2) loam; common medium prominent light olive brown (2.5Y 5/6) and few fine prominent strong brown (7.5YR 5/6) mottles; massive; friable; 3 percent gravel; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 30 to 44 inches. The thickness of the silty sediments over the loamy till ranges from 20 to 30 inches. The mollic epipedon is 16 to 24 inches thick. The upper sediments contain 0 to 2 percent coarse fragments, and the lower material contains 2 to 8 percent coarse fragments.

The A horizon has value of 2 or 3 and chroma of 0 to 1. It has mottles in the lower part in some pedons.

The Bg and 2Bg horizons have value of 4 or 5 and chroma of 1 or 2. The part of the Bg horizon in the upper sediment is silty clay loam or silt loam. The 2Bg horizon is loam or clay loam. The upper 5 inches of this horizon is sandy loam, or it is coarser in some pedons.

The 2C horizon is loam or clay loam. It has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 2 to 4.

Clyde Series

The Clyde series consists of poorly drained, moderately permeable soils on till plains. These soils formed in silty and loamy sediments and in underlying friable loamy drift and firm loamy till. Slopes range from 0 to 2 percent.

Typical pedon of Clyde silty clay loam, in Dexter Township, 100 feet north and 20 feet west of the southeast corner of sec. 10, T. 103 N., R. 16 W.

Ap—0 to 9 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; massive; friable; neutral; abrupt smooth boundary.

A1—9 to 16 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; weak fine granular structure; friable; neutral; clear wavy boundary.

A2—16 to 22 inches; very dark gray (5Y 3/1) silty clay loam, very dark gray (5Y 3/1) dry; weak fine granular structure; friable; neutral; clear wavy boundary.

2Bg1—22 to 27 inches; grayish brown (2.5Y 5/2) loam; few fine faint olive gray (5Y 5/2) mottles; weak fine subangular blocky structure; friable; 3 percent gravel; neutral; clear wavy boundary.

2Bg2—27 to 30 inches; yellowish brown (10YR 5/4) sandy loam; common fine prominent olive gray (5Y 5/2) mottles; single grained; friable; 2 percent gravel; neutral; clear wavy boundary.

2Bg3—30 to 40 inches; olive gray (5Y 5/2) and yellowish brown (10YR 5/4) sandy clay loam; few fine prominent strong brown (7.5Y 5/8) mottles; moderate medium subangular blocky structure; friable; 3 percent gravel; neutral; clear wavy boundary.

2Bg4—40 to 43 inches; yellowish brown (10YR 5/4) and strong brown (7.5YR 5/8) sandy loam; few fine prominent olive gray (5Y 5/2) mottles; weak subangular blocky structure; very friable; 2 percent gravel, 2 percent cobbles; neutral; clear wavy boundary.

2Bg5—43 to 50 inches; olive (5Y 5/4) loam; many fine prominent strong brown (7.5Y 5/8) mottles; moderate medium subangular blocky structure; firm; 2 percent gravel, 2 percent cobbles; neutral; clear wavy boundary.

2Cg—50 to 60 inches; olive (5Y 5/4) loam; many fine prominent strong brown (7.5YR 5/8) mottles; massive; firm; 4 percent gravel; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 36 to 55 inches. The depth to free carbonates is at least 45 inches. The mollic epipedon is 16 to 24 inches thick. The silty and loamy sediments are 18 to 38 inches thick. The upper sediments contain 0 to 2 percent coarse fragments, and the lower material contains 2 to 8 percent coarse fragments. Some pedons contain pebble bands that are as much as 20 percent coarse fragments.

The A horizon is silty clay loam or silt loam.

The 2Bg horizon has hue of 7.5YR to 5Y, value of 5 or 6, and chroma of 2 to 8. The 2Cg horizon has hue of 5Y to 7.5YR, value of 5 or 6, and chroma of 2 to 6. The

2Bg and 2Cg horizons are commonly loam, sandy loam, or sandy clay loam but in a few places contain strata of silty clay loam.

Coland Series

The Coland series consists of poorly drained, moderately permeable soils on flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Coland loam, in an area of Coland-Spillville loams, frequently flooded; in Marshall Township, 1,280 feet west and 150 feet south of the northeast corner of sec. 4, T. 102 N., R. 16 W.

A1—0 to 10 inches; black (10YR 2/1) loam; weak very fine granular structure; very friable; many fibrous roots; slightly acid; abrupt wavy boundary.

A2—10 to 18 inches; black (N 2/0) silty clay loam; moderate fine granular structure; friable; many fibrous roots; slightly acid; clear wavy boundary.

A3—18 to 40 inches; black (N 2/0) clay loam; moderate medium granular structure; friable; few fibrous roots; slightly acid; clear wavy boundary.

Bg—40 to 48 inches; very dark gray (10YR 3/1) silty clay loam; moderate medium subangular blocky structure; friable; common fine distinct brown (7.5YR 3/2) manganese concretions; slightly acid; clear wavy boundary.

BCg—48 to 55 inches; dark gray (10YR 4/1) silty clay loam; many prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; slightly acid; clear irregular boundary.

Cg—55 to 60 inches; dark gray (10YR 4/1) clay loam; massive; friable; slightly acid.

The thickness of the solum ranges from 36 to 60 inches. Free carbonates are at a depth of 48 inches or more. The mollic epipedon is 36 inches or more thick.

The A horizon has value of 2 or 3 and chroma of 0 or 1. The Bg and Cg horizons have hue of 10YR to 5Y, value of 3 to 5, and chroma of 1 or 2. They mainly are silty clay loam, clay loam, or loam. The Cg horizon in some pedons contains thin subhorizons of sand, loamy sand, or gravelly loamy sand.

Cylinder Series

The Cylinder series consists of somewhat poorly drained soils on outwash plains and stream terraces. The soils are moderately permeable in the solum and very rapidly permeable in the substratum. The soils formed in loamy sediments and in sandy underlying material. Slopes range from 0 to 2 percent.

Typical pedon of Cylinder loam, in Austin Township, 2,600 feet west and 1,500 feet north of the southeast corner of sec. 8, T. 102 N., R. 18 W.

Ap—0 to 11 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak very fine and fine granular structure; friable; 2 percent gravel; neutral; abrupt wavy boundary.

A—11 to 16 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; 3 percent gravel; mixed with dark brown (10YR 3/3) material; slightly acid; gradual wavy boundary.

Bw1—16 to 22 inches; dark grayish brown (10YR 4/2) loam; weak fine subangular blocky structure; friable; some very dark brown (10YR 2/2) material mixed by worms; 5 percent gravel; slightly acid; clear wavy boundary.

Bw2—22 to 28 inches; dark brown (10YR 4/3) loam; common fine faint dark grayish brown (10YR 4/2) mottles; weak medium subangular blocky structure; friable; 8 percent gravel; slightly acid; clear wavy boundary.

BC—28 to 31 inches; dark brown (10YR 4/3) sandy loam; common fine faint dark grayish brown (10YR 4/2) mottles; massive; friable; 12 percent gravel; slightly acid; clear wavy boundary.

2C1—31 to 40 inches; grayish brown (10YR 5/2) gravelly sand; single grained; loose; 18 percent gravel; neutral; clear wavy boundary.

2C2—40 to 60 inches; grayish brown (10YR 5/2) gravelly sand; single grained; loose; 18 percent gravel; slight effervescence; moderately alkaline.

The thickness of the loamy sediments and the solum is 24 to 40 inches. The depth to free carbonates is 30 to 50 inches. The mollic epipedon is 14 to 20 inches thick. The upper loamy layers contain 0 to 10 percent coarse fragments, and the sandy and gravelly layers mainly contain 5 to 30 percent coarse fragments, though thin layers in some pedons contain as much as 50 percent gravel.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is loam, silty clay loam, or clay loam. The Bw horizon has hue of 10YR or 2.5Y and value of 4 or 5. It has mottles in some or all parts. It is loam or clay loam in the upper part and sandy loam, loamy coarse sand, coarse sandy loam, or loamy sand in the lower part. The 2C horizon has value of 4 to 6 and chroma of 2 to 8. It has a fine earth fraction of loamy coarse sand, loamy sand, coarse sand, and sand with 5 to 30 percent gravel.

Dickinson Series

The Dickinson series consists of well drained soils on outwash plains and stream terraces. Permeability is moderately rapid in the upper part and rapid in the lower part. The soils formed in loamy sediments and sandy underlying material. Slopes range from 0 to 6 percent.

Typical pedon of Dickinson fine sandy loam, 2 to 6 percent slopes, in Nevada Township, 200 feet east and 50 feet north of the southwest corner of sec. 35, T. 101 N., R. 17 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) fine sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; very friable; slightly acid; abrupt wavy boundary.

A1—8 to 11 inches; very dark brown (10YR 2/2) fine sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; very friable; slightly acid; clear wavy boundary.

A2—11 to 16 inches; very dark gray (10YR 3/1) fine sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; very friable; slightly acid; clear wavy boundary.

Bw1—16 to 20 inches; brown (10YR 4/3) fine sandy loam; weak fine and medium subangular blocky structure; very friable; slightly acid; gradual wavy boundary.

Bw2—20 to 30 inches; yellowish brown (10YR 5/4) fine sandy loam; weak fine and medium subangular blocky structure; very friable; slightly acid; gradual wavy boundary.

Bw3—30 to 40 inches; yellowish brown (10YR 5/6) loamy sand; weak fine and medium subangular blocky structure; very friable; slightly acid; gradual wavy boundary.

C—40 to 60 inches; yellowish brown (10YR 5/4) sand; single grained; loose; slightly acid.

The thickness of the solum ranges from 24 to 50 inches. The thickness of the mollic epipedon ranges from 10 to 20 inches.

The A horizon is sandy loam, fine sandy loam, or loam.

The Bw horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 3 to 6. It is sandy loam or fine sandy loam in the upper part and loamy sand or loamy fine sand in the lower part.

The C horizon has value of 4 or 5 and chroma of 3 to 6. It is sand, fine sand, loamy sand, or loamy fine sand and is commonly stratified.

Donnan Series

The Donnan series consists of somewhat poorly drained and moderately well drained soils on till plains. Permeability is moderate in the upper part and very slow in the lower part. These soils formed in loamy sediments and in underlying very firm clayey paleosols. Slopes range from 0 to 2 percent.

Typical pedon of Donnan silt loam, in Austin Township, 750 feet west and 2,580 feet north of the southeast corner of sec. 19, T. 102 N., R. 18 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 4/3) dry; massive; friable; medium acid; abrupt smooth boundary.

E—8 to 12 inches; dark grayish brown (10YR 4/2) loam, brown (10YR 5/3) dry; moderate very fine subangular structure; friable; strongly acid; abrupt wavy boundary.

BE—12 to 18 inches; yellowish brown (10YR 5/4) loam; moderate very fine and fine angular blocky structure; friable; few distinct brown (10YR 5/3) clay films on faces of peds; few distinct sand and silt coatings on faces of peds; strongly acid; abrupt wavy boundary.

Bt1—18 to 23 inches; brown (10YR 5/3) clay loam; moderate fine and medium subangular and angular blocky structure; firm; continuous sand and silt coatings on faces of peds; few distinct grayish brown (10YR 5/2) clay films on faces of peds; strongly acid; abrupt wavy boundary.

Bt2—23 to 29 inches; light olive brown (2.5Y 5/4) clay loam; common medium distinct grayish brown (10YR 5/2) mottles; strong fine angular blocky structure; very firm; few distinct dark grayish brown (10YR 5/2) clay films on faces of peds; strongly acid; clear wavy boundary.

2Bt3—29 to 41 inches; dark gray (5Y 4/1) silty clay; common coarse prominent brown (10YR 5/3) mottles; very fine prismatic structure; very firm; 3 percent gravel; strongly acid; clear wavy boundary.

2Bt4—41 to 60 inches; gray (5Y 5/1) silty clay; common coarse prominent dark grayish brown (10YR 4/2) mottles; massive; very firm; few faint clay films on faces of peds; medium acid.

The thickness of the solum is at least 40 inches. The loamy sediments are 20 to 36 inches thick. In some pedons pebble bands that contain 0 to 2 percent coarse fragments are at the base of the loamy sediments.

The A or Ap horizon has value of 2 or 3 and chroma of 1 or 2. It is loam or silt loam.

The E horizon has value of 4 or 5 and chroma of 2 or 3.

The Bt horizon in the loamy sediments has value of 4 or 5. The content of mottles ranges from few to many, and they are faint to prominent. The Bt horizon is loam, clay loam, or silty clay loam.

The 2Bt horizon has hue of 2.5Y or 5Y and chroma of 1 or 2.

Dowagiac Series

The Dowagiac series consists of well drained soils on outwash plains and stream terraces. Permeability is moderate in the upper part and rapid in the lower part. The soils formed in loamy sediments and sandy underlying material. Slopes range from 0 to 6 percent.

Typical pedon of Dowagiac loam, 2 to 6 percent slopes, in Austin Township, 2,200 feet east and 1,200 feet south of the northwest corner of sec. 26, T. 102 N., R. 18 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; friable; 3 percent gravel; medium acid; abrupt wavy boundary.

E—6 to 10 inches; brown (10YR 5/3) loam, light gray (10YR 7/2) dry; weak very thin and thin platy structure; friable; 3 percent gravel; common distinct sand and silt coatings on faces of peds; medium acid; abrupt wavy boundary.

Bt1—10 to 17 inches; dark yellowish brown (10YR 4/4) loam; moderate fine and medium subangular blocky structure; friable; 3 percent gravel; common distinct dark brown (10YR 4/3) coatings on faces of peds; few faint clay films on faces of peds; strongly acid; clear wavy boundary.

Bt2—17 to 25 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine and medium subangular blocky structure; friable; 5 percent gravel; common distinct dark brown (10YR 4/3) clay bridges on sand grains; strongly acid; clear wavy boundary.

Bt3—25 to 30 inches; dark yellowish brown (10YR 4/4) sandy loam; weak coarse subangular blocky structure; friable; 5 percent gravel; common distinct brown to dark brown (7.5YR 4/2) clay bridges on sand grains; strongly acid; clear wavy boundary.

2BC—30 to 43 inches; dark yellowish brown (10YR 4/4) coarse sand; single grained; loose; 8 percent gravel; brown to dark brown (7.5YR 4/2) bands; slightly acid; abrupt wavy boundary.

2C—43 to 60 inches; brown (10YR 5/3) coarse sand; single grained; 12 percent gravel; loose; neutral.

The loamy sediment is typically 25 to 30 inches thick but ranges to 40 inches. The depth to free carbonates is at least 40 inches. The A, E, and Bt horizons contain 0 to 10 percent coarse fragments, and the 2B and 2C horizons have 5 to 35 percent coarse fragments.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has value of 4 or 5 and chroma of 2 or 3. The A and E horizons are loam or sandy loam.

The Bt horizon has hue of 10YR and 7.5YR and value and chroma of 3 or 4. It is loam, clay loam, sandy clay loam, or sandy loam.

The 2BC horizon has value of 4 or 5 and chroma of 3 to 6. It is loamy sand, sand, coarse sand, or loamy coarse sand or their gravelly analogs.

The 2C horizon has value of 4 to 6 and chroma of 3 or 4.

Fairhaven Series

The Fairhaven series consists of well drained soils on outwash plains and stream terraces. Permeability is moderate in the upper part and rapid in the lower part. These soils formed in loamy sediments and sandy underlying material. Slopes range from 0 to 6 percent.

Typical pedon of Fairhaven silt loam, 0 to 2 percent slopes, in Udolpho Township, 100 feet west and 300 feet south of the northeast corner of sec. 5, T. 104 N., R. 18 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) silt loam, dark brown (10YR 3/3) dry; weak fine granular structure; friable; slightly acid; abrupt wavy boundary.

A—9 to 15 inches; very dark brown (10YR 2/2) silt loam, dark brown (10YR 3/3) dry; moderate fine granular structure; friable; mixed with very dark grayish brown (10YR 3/2) material; medium acid; abrupt wavy boundary.

Bw1—15 to 25 inches; dark brown (10YR 4/3) silt loam; weak fine and medium subangular blocky structure; friable; medium acid; abrupt wavy boundary.

Bw2—25 to 30 inches; dark brown (10YR 4/3) loam; weak coarse subangular blocky structure; loose; 3 percent gravel; medium acid; clear wavy boundary.

2BC—30 to 35 inches; dark brown (10YR 4/3) loamy sand; single grained; loose; 10 percent gravel; slightly acid; abrupt wavy boundary.

2C—35 to 60 inches; brown (10YR 5/3) gravelly coarse sand; single grained; loose; 15 percent gravel; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 26 to 50 inches. The depth to free carbonates ranges from 30 to

50 inches. The loamy sediment is typically 22 to 40 inches thick. The mollic epipedon ranges from 10 to 20 inches in thickness. The coarse fragment volume ranges mainly from 5 to 30 percent in the 2BC and 2C horizons, but some thin layers contain as much as 50 percent gravel.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is loam, silt loam, or silty clay loam. The Bw horizon in the upper sediments has value and chroma of 3 or 4. The 2C horizon has value of 5 or 6 and chroma of 3 or 4. It is typically gravelly coarse sand but in some pedons is stratified with sand or coarse sand or their gravelly analogs.

Faxon Variant

The Faxon Variant consists of poorly drained, moderately permeable soils on bedrock-controlled uplands. These soils formed in loamy glacial drift over soft weathered limestone. Slopes range from 0 to 2 percent.

Typical pedon of Faxon Variant silty clay loam, in Austin Township, 900 feet east and 1,600 feet north of the southwest corner of sec. 35, T. 102 N., R. 18 W.

Ap—0 to 10 inches; black (10YR 2/1) silty clay loam, black (10YR 2/1) dry; weak very fine granular structure; friable; neutral; abrupt wavy boundary.

A—10 to 14 inches; very dark gray (10YR 3/1) silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate fine subangular blocky structure parting to weak very fine granular; friable; neutral; abrupt wavy boundary.

Bg1—14 to 18 inches; dark grayish brown (2.5Y 4/2) silty clay loam; few fine distinct light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; friable; neutral; clear wavy boundary.

Bg2—18 to 23 inches; olive gray (5Y 5/2) silt loam; many fine prominent light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; friable; neutral; abrupt wavy boundary.

Bg3—23 to 37 inches; grayish brown (10YR 5/2) clay loam; many medium prominent light olive brown (2.5Y 5/6) mottles; weak medium subangular blocky structure; friable; 5 percent gravel; neutral; abrupt wavy boundary.

2C—37 to 60 inches; yellowish brown (10YR 5/6) channery silt loam; massive; friable; 20 percent soft weathered limestone channers; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 24 to 40 inches. The mollic epipedon ranges from 12 to 20 inches in thickness.

The A horizon has chroma of 1 or is neutral. It is silty clay loam, silt loam, loam, or clay loam.

The Bg horizon has chroma of 1 or 2. It has distinct or prominent mottles in some or all parts. The B horizon is silty clay loam, clay loam, loam, or silt loam.

The 2C horizon has hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 3 to 8. It is the channery analogs of silt loam, loam, fine sandy loam, or sandy loam. The 2C horizon consists of 15 to 35 percent channery fragments of soft weathered limestone.

Floyd Series

The Floyd series consists of somewhat poorly drained, moderately permeable soils on till plains. The soils formed in loamy sediments and in underlying friable loamy drift and firm loamy till. Slopes range from 1 to 3 percent.

Typical pedon of Floyd silt loam, in Marshall Township, 900 feet east and 50 feet north of the southwest corner of sec. 18, T. 102 N., R. 16 W.

Ap—0 to 10 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; 2 percent gravel; slightly acid; abrupt wavy boundary.

A—10 to 17 inches; very dark grayish brown (10YR 3/2) silt loam, dark brown (10YR 3/3) dry; weak fine and medium subangular blocky and granular structure; friable; 2 percent gravel; slightly acid; abrupt wavy boundary.

Bw1—17 to 28 inches; dark grayish brown (10YR 4/2) sandy clay loam; common fine faint dark brown (10YR 4/3) mottles; weak medium and coarse subangular blocky structure; friable; 2 percent gravel; very dark grayish brown (10YR 3/2) coatings on faces of peds; slightly acid; abrupt wavy boundary.

Bw2—28 to 39 inches; dark grayish brown (2.5Y 4/2) sandy clay loam; many common distinct olive brown (2.5Y 4/4) mottles; moderate medium angular and subangular blocky structure; friable; 3 percent gravel; light gray (10YR 7/2) sand and silt coatings on faces of peds; slightly acid; abrupt wavy boundary.

2Bw3—39 to 49 inches; dark grayish brown (2.5Y 4/2) loam; many medium prominent yellowish brown (10YR 5/6) mottles; moderate coarse angular blocky structure; firm; 3 percent gravel; slightly acid; clear wavy boundary.

2C—49 to 60 inches; olive brown (2.5Y 4/4) loam; many medium prominent yellowish brown (10YR 5/6) mottles; massive; firm; 3 percent gravel; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 40 to 60 inches. The depth to free carbonates typically ranges from 45 to 75 inches. The content of coarse fragments ranges from 2 to 5 percent in the solum and 2 to 10 percent in the loamy till. Some pedons have a stone line that is as much as 20 percent gravel or cobbles. The thickness of the mollic epipedon ranges from 15 to 24 inches.

The A horizon has chroma of 1 or 2. It mainly is silt loam or loam but ranges to clay loam or silty clay loam.

The Bw horizon has value of 4 or 5 and chroma of 2 to 4. The part of the B horizon in the loamy sediments is loam, sandy clay loam, or sandy loam.

The 2Bw horizon has hue of 2.5Y or 10YR and chroma of 2 or 3. It mainly is loam, sandy clay loam, or clay loam. In a few pedons loamy sand is at contact with upper loamy sediments.

The 2C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It has few to many low- or high-chroma mottles.

Havana Series

The Havana series consists of poorly drained, moderately slowly permeable soils on moraines. The soils formed in silty and loamy sediments and the underlying friable loamy calcareous till. Slopes range from 0 to 2 percent.

Typical pedon of Havana silt loam in Austin Township, 2,200 feet west and 2,320 feet north of the southeast corner of sec. 5, T. 102 N., R. 18 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silt loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable; slightly acid; abrupt smooth boundary.

E—8 to 11 inches; dark gray (10YR 4/1) silt loam, gray (10YR 5/1) dry; moderate fine platy structure; friable; neutral; clear wavy boundary.

Btg1—11 to 15 inches; grayish brown (2.5Y 5/2) silt loam; few fine faint gray (10YR 5/1) mottles; weak fine subangular blocky structure; friable; few faint grayish brown (10YR 5/2) coatings on faces of peds; medium acid; clear wavy boundary.

Btg2—15 to 22 inches; grayish brown (2.5Y 5/2) silty clay loam; few fine faint gray (10YR 5/1) mottles; moderate fine and medium subangular blocky structure; friable; few faint grayish brown (10YR 5/2) coatings on faces of peds; medium acid; clear wavy boundary.

2Btg3—22 to 32 inches; grayish brown (2.5Y 5/2) loam; few fine faint gray (10YR 5/1) mottles; weak medium subangular blocky structure; friable; 3 percent gravel; medium acid; abrupt wavy boundary.

2BCg—32 to 40 inches; grayish brown (2.5Y 5/2) loam; many coarse prominent yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; friable; 3 percent gravel; medium acid; gradual wavy boundary.

2C—40 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; 3 percent gravel; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates are at least 36 inches. The thickness of the silty and loamy sediments ranges from 18 to 24 inches. The silty and loamy sediments contain less than 2 percent coarse fragments, and the loamy lower layers contain 2 to 8 percent coarse fragments.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is silt loam or loam. The E horizon has value of 4 or 5 and chroma of 1 or 2. It has none to many mottles. It is silt loam or loam. The Btg horizon in the silty and loamy sediments has value of 4 or 5. It has none to many and faint to prominent mottles. It is silt loam, silty clay loam, or loam. The 2Btg horizon mainly is loam or clay loam, but it ranges to sandy loam or loamy sand in the upper part in some pedons. It has value of 3 to 6. The 2C horizon has value of 4 or 5 and chroma of 2 to 4.

Hayfield Series

The Hayfield series consists of moderately well drained and somewhat poorly drained soils on outwash plains and stream terraces. The soils are moderately permeable in the upper part and rapidly permeable in the lower part. These soils formed in loamy sediments and in sandy underlying material. Slopes range from 1 to 3 percent.

Typical pedon of Hayfield loam, in Austin Township, 2,595 feet north and 65 feet east of the southwest corner of sec. 33, T. 102 N., R. 18 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

E—8 to 13 inches; dark grayish brown (10YR 4/2) loam, grayish brown (10YR 5/2) dry; few fine faint dark yellowish brown (10YR 4/4) mottles; weak medium platy structure; friable; common fine pores; many distinct very dark grayish brown (10YR 3/2) sand and silt coatings on faces of peds; medium acid; abrupt wavy boundary.

Bt1—13 to 24 inches; brown (10YR 4/3) loam; few fine distinct grayish brown (10YR 5/2) and light olive brown (2.5Y 5/4) mottles; weak medium subangular blocky structure; friable; few fine pores; few common distinct grayish brown (10YR 5/2) sand and silt coatings on faces of peds; few faint clay films in pores; medium acid; clear wavy boundary.

Bt2—24 to 29 inches; brown (10YR 4/3) loam; many fine faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; few fine pores; common faint clay films between sand grains and on faces of peds; medium acid; clear wavy boundary.

2C—29 to 60 inches; yellowish brown (10YR 5/4) coarse sand; common medium faint grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; single grained; loose; 5 percent gravel; slightly acid.

The thickness of the solum is 24 to 40 inches. The loamy sediment is 20 to 40 inches thick. The depth to free carbonates is 48 to 80 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has value of 4 or 5. The A and E horizons are silt loam or loam.

The upper part of the Bt horizon has value of 4 or 5 and chroma of 3 or 4. It has few or common mottles. It is silt loam or loam. The lower part of the Bt horizon has value of 4 or 5 and chroma of 2 to 4. It has few to common mottles. It is silt loam, loam, or sandy clay loam.

A 2BC horizon is in some pedons.

The 2C horizon has value of 4 or 5 and chroma of 2 to 4. There are dark concretions in some pedons. It is coarse sand, sand, loamy coarse sand, or loamy sand and is as much as 35 percent gravel.

Kalmarville Series

The Kalmarville series consists of poorly drained and very poorly drained soils on the flood plains. Permeability is moderate and moderately rapid in the upper part and rapid in the lower part. These soils formed in recent alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Kalmarville loam, frequently flooded, in Lansing Township, 1,600 feet west and 100 feet north of the southeast corner of sec. 11, T. 103 N., R. 18 W.

Ap—0 to 10 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; very friable; mildly alkaline; clear smooth boundary.

A—10 to 50 inches; very dark brown (10YR 2/2) stratified fine sandy loam, sandy loam, and silt loam; very dark grayish brown (10YR 3/2) dry; weak very fine granular structure; very friable; mildly alkaline; gradual wavy boundary.

C—50 to 60 inches; dark grayish brown (10YR 4/2) stratified sand and loamy fine sand; single grained; loose; mildly alkaline.

The thickness of the loamy sediments is at least 40 inches. The soils have free carbonates in parts of some pedons. Some pedons have layers with up to 5 percent gravel.

The A horizon has value of 2 to 4 and chroma of 1 or 2. It is loam, sandy loam, fine sandy loam, loamy fine sand, or silt loam.

The C horizon has value of 3 to 5 and chroma of 1 or 2. It is coarse sand, sand, fine sand, loamy coarse sand, loamy sand, or loamy fine sand.

Kasson Series

The Kasson series consists of moderately well drained, moderately slowly permeable soils on till plains. These soils formed in silty and loamy sediments and in underlying firm loamy till. Slopes range from 1 to 4 percent.

Typical pedon of Kasson silt loam, 1 to 4 percent slopes, in Windom Township, 2,200 feet north and 100 feet west of the southeast corner of sec. 2, T. 102 N., R. 17 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; massive; friable; slightly acid; abrupt smooth boundary.

E—7 to 11 inches; dark grayish brown (10YR 4/3) silt loam, grayish brown (10YR 5/3) dry; moderate medium platy structure; friable; slightly acid; clear wavy boundary.

Bt1—11 to 16 inches; dark brown (10YR 4/3) silty clay loam; weak fine and medium subangular blocky structure; friable; common faint dark grayish brown (10YR 4/2) coatings on faces of peds; medium acid; clear wavy boundary.

Bt2—16 to 18 inches; dark brown (10YR 4/3) loam; common medium faint dark grayish brown (10YR

4/2) mottles; weak fine and medium subangular blocky structure; friable; common faint dark grayish brown (10YR 4/2) coatings on faces of peds; strongly acid; clear wavy boundary.

2Bt3—18 to 26 inches; brown (10YR 5/3) loam; common medium faint grayish brown (10YR 5/2) mottles; weak medium and coarse prismatic structure parting to moderate medium subangular blocky; firm; 3 percent gravel; many distinct light brownish gray (10YR 6/2) sand and silt coatings on faces of peds; strongly acid; clear wavy boundary.

2Bt4—26 to 37 inches; dark yellowish brown (10YR 4/4) loam; moderate medium and coarse prismatic structure parting to moderate medium subangular blocky; firm; 3 percent gravel; many prominent light brownish gray (10YR 6/2) sand and silt coatings on faces of peds; strongly acid; clear wavy boundary.

2Bt5—37 to 53 inches; dark yellowish brown (10YR 4/4) loam; weak coarse prismatic structure parting to weak medium subangular blocky; firm; 3 percent gravel; few prominent light brownish gray (10YR 6/2) sand and silt coatings on faces of peds; medium acid; clear wavy boundary.

2C—53 to 60 inches; yellowish brown (10YR 5/4) loam; massive; firm; 3 percent gravel; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates typically range from 45 to 55 inches. The silty sediment is 16 to 24 inches thick. The 2Bt and 2C horizons contain 2 to 8 percent coarse fragments.

The A or Ap horizon has value of 2 or 3 and chroma of 1 and 2.

The E horizon has value of 4 or 5 and chroma of 2 or 3.

The Bt horizon has value of 4 or 5 and chroma of 3 or 4. It has few to common mottles. It is silty clay loam, loam, or silt loam.

The content of mottles in the 2Bt horizon is none to many. A sandy loam or coarser textured layer as much as 5 inches thick is in the upper part of the 2Bt horizon in some pedons.

The 2C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 4 to 8. It is loam or sandy clay loam.

Kensett Variant

The Kensett Variant consists of somewhat poorly drained, moderately permeable soils on bedrock-controlled uplands. The soils formed in loamy sediments over soft weathered limestone. Slopes range from 0 to 2 percent.

Typical pedon of Kensett Variant silt loam, in Austin Township, 2,500 feet east and 2,100 feet north of the southwest corner of sec. 12, T. 102 N., R. 18 W.

Ap—0 to 10 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) dry; weak very fine granular structure; friable; neutral; abrupt wavy boundary.

A—10 to 13 inches; very dark brown (10YR 2/2) silt loam, dark brown (10YR 3/3) dry; moderate very fine granular structure; friable; neutral; clear wavy boundary.

Bw1—13 to 16 inches; dark grayish brown (2.5Y 4/2) clay loam; moderate very fine angular blocky structure; friable; few fine prominent yellowish brown (10YR 5/6) mottles; neutral; abrupt wavy boundary.

Bw2—16 to 24 inches; olive brown (2.5Y 4/4) clay loam; moderate fine angular blocky structure; firm; neutral; clear wavy boundary.

2C1—24 to 50 inches; yellowish brown (10YR 5/6) channery silt loam; massive; friable; 20 percent soft weathered limestone channers; strong effervescence; mildly alkaline.

2C2—50 to 60 inches; brownish yellow (10YR 6/6) channery silt loam; massive; friable; 30 percent soft weathered limestone channers; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 24 to 40 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It mainly is silt loam, but in places it is loam.

The Bw horizon has value of 4 or 5 and chroma of 2 to 5. The B horizon is clay loam or loam.

The 2C horizon has hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 4 to 8. It is the channery analogs of silt loam, loam, fine sandy loam, or sandy loam. The 2C horizon has 15 to 35 percent soft weathered limestone channers.

Kenyon Series

The Kenyon series consists of moderately well drained and well drained, moderately permeable soils on till plains. The soils formed in silty and loamy sediments and in underlying firm loamy till. Slopes range from 1 to 6 percent.

Typical pedon of Kenyon silt loam, 1 to 6 percent slopes, in Marshall Township, 2,480 feet south and 480 feet east of the northwest corner of sec. 11, T. 102 N., R. 16 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; cloddy; friable; slightly acid; abrupt wavy boundary.

A1—8 to 12 inches; very dark brown (10YR 2/2) silt loam; very dark grayish brown (10YR 3/2) dry; moderate very fine and fine granular structure; friable; very dark grayish brown (10YR 3/2) coatings on faces of peds; medium acid; abrupt wavy boundary.

A2—12 to 16 inches; very dark grayish brown (10YR 3/2) silt loam; dark brown (10YR 3/3) dry; moderate very fine subangular blocky structure; friable; dark brown (10YR 3/3) coatings on faces of peds; medium acid; abrupt wavy boundary.

Bw1—16 to 24 inches; dark brown (10YR 4/3) silt loam; weak to moderate very fine and fine subangular blocky structure; friable; dark grayish brown (2.5Y 4/2) coatings on faces of peds; medium acid; abrupt wavy boundary.

2Bw2—24 to 31 inches; yellowish brown (10YR 5/4) loam; moderate fine subangular blocky structure; firm; 5 percent gravel; medium acid; clear wavy boundary.

2Bw3—31 to 48 inches; yellowish brown (10YR 5/4) loam; few fine faint dark grayish brown (10YR 4/2) mottles; weak medium prismatic structure; firm; 3 percent gravel, 2 percent cobbles; thin seams of sand; slightly acid; clear wavy boundary.

2C—48 to 60 inches; yellowish brown (10YR 5/4) loam; massive; firm; 5 percent gravel; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 45 to 66 inches. The thickness of the loamy sediments ranges from 14 to 24 inches. The underlying loamy till typically contains 5 to 12 percent rock fragments of pebble- to boulder-size. In some pedons one or more stone lines 2 to 6 inches thick that contain as much as 30 percent pebble- to cobble-size fragments are between the loamy sediments and the loamy till.

The A horizon is loam or silt loam.

The Bw horizon has chroma of 2 or 3. It is loam, silt loam, or clay loam.

The 2Bw horizon has value of 4 or 5 and chroma of 4 to 6.

The 2C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6.

Lawler Series

The Lawler series consists of somewhat poorly drained soils on outwash plains and stream terraces. Permeability is moderate in the upper part and very rapid in the lower part. The soils formed in silty and loamy sediments and in sandy and gravelly underlying materials. Slopes range from 0 to 2 percent.

Typical pedon of Lawler silt loam, in Marshall Township, 1,700 feet east and 50 feet south of the northwest corner of sec. 5, T. 102 N., R. 16 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, very dark brown (10YR 2/2) dry; weak very fine granular structure; very friable; neutral; abrupt wavy boundary.

A—9 to 14 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure; very friable; medium acid; clear wavy boundary.

Bw1—14 to 20 inches; dark grayish brown (10YR 4/2) silt loam; weak fine subangular blocky structure; friable; medium acid; clear wavy boundary.

Bw2—20 to 29 inches; dark grayish brown (2.5Y 4/2) loam; many medium faint light olive brown (2.5Y 5/6) mottles; moderate fine subangular blocky structure; friable; medium acid; clear wavy boundary.

BC—29 to 32 inches; grayish brown (2.5Y 5/2) sandy loam; common medium faint light olive brown (2.5Y 5/6) mottles; weak coarse subangular blocky structure; very friable; medium acid; abrupt wavy boundary.

2C1—32 to 45 inches; grayish brown (2.5Y 5/2) gravelly coarse sand; single grained; loose; 15 percent gravel; slightly acid; clear wavy boundary.

2C2—45 to 60 inches; grayish brown (2.5Y 5/2) gravelly coarse sand; single grained; loose; 15 percent gravel; neutral.

The thickness of the loamy sediment is 24 to 40 inches. The depth to free carbonates is greater than 60 inches. The mollic epipedon is 12 to 20 inches thick.

The A horizon has value of 2 or 3. It is loam or silt loam.

The Bw horizon has value of 4 or 5 and chroma of 2 or 3. It has mottles in some or all parts. It is loam, silt loam, or clay loam in the upper part and sandy loam, loamy coarse sand, coarse sandy loam, or loamy sand in the lower part.

The 2C horizon has value of 4 or 5 and chroma of 1 or 2. It has a fine earth fraction of coarse sand, loamy sand, or sand and is 5 to 30 percent gravel.

Lilah Series

The Lilah series consists of excessively drained soils on outwash plains and stream terraces. Permeability is moderately rapid in the upper part and very rapid in the lower part. The soils formed in loamy sediments and sandy and gravelly underlying materials. Slopes range from 0 to 12 percent.

Typical pedon of Lilah sandy loam, 2 to 6 percent slopes, in Le Roy Township, 1,950 feet west and 250 feet south of the northeast corner of sec. 35, T. 101 N., R. 14 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) sandy loam, dark brown (10YR 3/3) dry; weak very fine granular structure; friable; 6 percent gravel; strongly acid; abrupt wavy boundary.

Bt1—8 to 16 inches; brown (10YR 4/3) sandy loam; weak to moderate fine subangular blocky structure; friable; common distinct clay films on faces of peds; 10 percent gravel; strongly acid; abrupt wavy boundary.

2Bt2—16 to 36 inches; brown (10YR 5/3) gravelly loamy sand; weak coarse subangular blocky structure; loose; 15 percent gravel; few distinct clay bridges between sand grains; strongly acid; abrupt wavy boundary.

2C—36 to 60 inches; yellowish brown (10YR 5/4) gravelly coarse sand; single grained; loose; 20 percent gravel; medium acid.

The solum thickness ranges from 30 to 42 inches. The depth to loamy sand or coarser material is 11 to 20 inches. The volume of gravel mainly ranges from 5 to 25 percent, though some thin layers contain as much as 50 percent.

The A horizon has value of 2 or 3 and chroma of 1 or 2.

The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. It is typically sandy loam or gravelly sandy loam.

The 2Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is loamy sand, gravelly loamy sand, or sand.

The 2C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6.

Marshan Series

The Marshan series consists of poorly drained soils on outwash plains and stream terraces. Permeability is moderate in the upper part and rapid in the lower part. These soils formed in loamy sediments and sandy and gravelly underlying materials. Slopes range from 0 to 2 percent.

Typical pedon of Marshan clay loam, in Austin Township, 1,150 feet east and 60 feet north of the southwest corner of sec. 9, T. 102 N., R. 18 W.

Ap—0 to 10 inches; black (10YR 2/1) clay loam, black (10YR 2/1) dry; weak fine subangular blocky structure; friable; slightly acid; abrupt wavy boundary.

A—10 to 14 inches; very dark gray (10YR 3/1) clay loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; friable; slightly acid; clear wavy boundary.

Bg1—14 to 21 inches; dark gray (10YR 4/1) clay loam; weak fine subangular blocky structure; few fine distinct brown (10YR 5/3) mottles; few very dark gray (10YR 3/1) coatings on faces of peds; friable; slightly acid; gradual wavy boundary.

Bg2—21 to 26 inches; gray (5Y 5/1) clay loam; many fine prominent brown (10YR 5/3) mottles; weak medium subangular blocky structure; friable; slightly acid; clear wavy boundary.

Bg3—26 to 29 inches; dark gray (5Y 4/1) sandy loam; many fine prominent brown (10YR 5/3) mottles; weak coarse subangular blocky structure; friable; slightly acid; clear wavy boundary.

2Cg—29 to 40 inches; grayish brown (10YR 5/2) coarse sand; many coarse distinct yellowish brown (10YR 5/4) mottles; single grained; loose; 5 percent gravel; neutral; clear wavy boundary.

2C—40 to 60 inches; yellowish brown (10YR 5/4) gravelly coarse sand; many coarse distinct yellowish brown (10YR 5/6) mottles; single grained; loose; 18 percent gravel; neutral.

The thickness of the solum and the depth to the 2C horizon range from 24 to 40 inches. The mollic epipedon ranges from 12 to 24 inches in thickness.

The A horizon has chroma of 1 or is neutral. It mainly is clay loam, but the range in texture includes silty clay loam, loam, or silt loam.

The Bg horizon has chroma of 1 or 2. It has distinct or prominent mottles in some to all parts. The upper part of the Bg horizon is silty clay loam, clay loam, loam, or silt loam. The lower part of the Bg horizon mainly is loam or sandy loam but includes silt loam or clay loam.

The 2C horizon is gravelly sand, gravelly coarse sand, or coarse sand and contains 5 and 30 percent gravel. It has value of 4 or 5.

Maxcreek Series

The Maxcreek series consists of poorly drained and very poorly drained, moderately permeable soils on moraines. These soils formed in silty sediments and in underlying friable loamy till. Slopes range from 0 to 2 percent.

Typical pedon of Maxcreek silty clay loam, in Lansing Township, 2,550 feet west and 1,100 feet north of the southeast corner of sec. 17, T. 103 N., R. 18 W.

Ap—0 to 10 inches; black (10YR 2/1) silty clay loam, black (10YR 2/1) dry; weak medium subangular blocky structure; friable; neutral; abrupt wavy boundary.

A—10 to 18 inches; very dark gray (10YR 3/1) silty clay loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; neutral; clear wavy boundary.

Bg1—18 to 28 inches; dark gray (5Y 4/1) silt loam; few fine distinct olive (5Y 5/3) mottles; weak fine subangular blocky structure; friable; neutral; clear wavy boundary.

2Bg2—28 to 35 inches; olive gray (5Y 5/2) loam; many coarse faint olive (5Y 5/3) mottles; weak fine subangular blocky structure; friable; 3 percent gravel; neutral; clear wavy boundary.

2Cg—35 to 60 inches; olive gray (5Y 5/2) loam; many coarse faint olive (5Y 5/3) mottles; massive; friable; 3 percent gravel; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates typically range from 30 to 44 inches. In places the solum is calcareous throughout. The thickness of the silty sediments over the loamy till ranges from 26 to 40 inches. The mollic epipedon is 16 to 24 inches thick. The 2Bg and 2Cg horizons are 2 to 8 percent coarse fragments, by volume.

The A horizon has chroma of 0 or 1. It has mottles in the lower part in some pedons. The B and 2B horizons have hue of 2.5YR to 5Y. The Bg horizon is silty clay loam or silt loam. The 2Bg horizon typically is loam or clay loam. The upper 5 inches of this horizon is sandy loam in some pedons. The 2Cg horizon has chroma of 2 to 4 and is loam or sandy clay loam.

Mayer Series

The Mayer series consists of poorly drained soils on outwash plains and stream terraces. Permeability is moderate in the upper part and rapid in the lower part. These soils formed in loamy sediments and sandy underlying materials. Slopes range from 0 to 2 percent.

Typical pedon of Mayer loam, in Udolpho Township, 2,600 feet east and 150 feet north of the southwest corner of sec. 32, T. 104 N., R. 18 W.

Ap—0 to 8 inches; black (N 2/0) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; violent effervescence; mildly alkaline; abrupt smooth boundary.

A1—8 to 14 inches; black (N 2/0) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; violent effervescence; mildly alkaline; clear wavy boundary.

A2—14 to 20 inches; very dark gray (10YR 3/1) loam, very dark gray (10YR 3/1) dry; few fine faint dark gray (10YR 4/1) mottles; weak fine subangular blocky structure; friable; strong effervescence; mildly alkaline; clear wavy boundary.

Bg1—20 to 26 inches; olive gray (5Y 5/2) loam; few fine distinct olive brown (2.5Y 4/4) mottles; weak fine subangular blocky structure; friable; strong effervescence; mildly alkaline; clear wavy boundary.

Bg2—26 to 30 inches; olive gray (5Y 5/2) sandy clay loam; many fine and medium faint olive gray (5Y 4/2) mottles; weak very fine subangular blocky structure; friable; strong effervescence; mildly alkaline; clear wavy boundary.

BC—30 to 36 inches; olive (5Y 5/3) sandy loam; many fine and medium faint olive gray (5Y 4/2) mottles; massive; friable; loose; strong effervescence; mildly alkaline; abrupt wavy boundary.

2C—36 to 60 inches; dark brown (10YR 4/3) gravelly coarse sand; many fine faint dark grayish brown (10YR 4/2) mottles; single grained; loose; 20 percent gravel; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to the 2C horizon range from 24 to 40 inches. The mollic epipedon ranges from 14 to 24 inches in thickness.

The A horizon is loam or silt loam. The Bg horizon has value of 4 or 5 and chroma of 1 or 2. It has faint or distinct mottles in some to all parts. The Bg horizon is sandy clay loam, loam, or silt loam.

The 2C horizon is gravelly sand, gravelly coarse sand, or coarse sand.

Merton Series

The Merton series consists of moderately well drained and somewhat poorly drained, moderately permeable soils on moraines. These soils formed in silty sediments and underlying calcareous friable loamy till. Slopes range from 1 to 3 percent.

Typical pedon of Merton silt loam, in Udolpho Township, 100 feet north and 100 feet east of the southwest corner of sec. 17, T. 104 N., R. 18 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, very dark brown (10YR 2/2) dry; massive; friable; slightly acid; abrupt smooth boundary.
A—8 to 16 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; slightly acid; clear wavy boundary.
Bw1—16 to 23 inches; dark grayish brown (2.5Y 4/2) silt loam; weak fine subangular blocky structure; friable; slightly acid; clear wavy boundary.
2Bw2—23 to 29 inches; grayish brown (2.5Y 5/2) loam; weak fine and medium subangular blocky structure; friable; 3 percent gravel; slightly acid; clear wavy boundary.
2Bw3—29 to 36 inches; grayish brown (2.5Y 5/2) loam; few fine faint light olive brown (2.5Y 5/4) mottles; weak medium subangular blocky structure; friable; 3 percent gravel; slightly acid; clear wavy boundary.
2Bw4—36 to 44 inches; light olive brown (2.5Y 5/4) loam; many fine faint grayish brown (2.5Y 5/2) mottles; moderate medium subangular blocky structure; friable; 3 percent gravel; slight effervescence; neutral; clear wavy boundary.
2C—44 to 60 inches; light olive brown (2.5Y 5/4) loam; few fine faint grayish brown (2.5Y 5/2) mottles; massive; friable; 3 percent gravel; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 36 to 66 inches. The mollic epipedon is 12 to 18 inches thick. The silty sediment is 14 to 24 inches thick. The 2Bw and 2C horizons contain 2 to 6 percent coarse fragments.

The A horizon has value of 2 or 3. It is silt loam, loam, or silty clay loam.

The Bw horizon in the upper sediment has value of 4 or 5 and chroma of 2 or 3 with or without mottles. It is silt loam or loam.

The 2Bw horizon has value of 4 or 5. It has few to many mottles in most parts. It mainly is clay loam or loam, but a layer as much as 5 inches thick of sandy loam or one that is coarser textured is in the upper part in some pedons.

The 2C horizon has value of 4 or 5 and chroma of 2 to 4. It is loam or sandy loam.

Moland Series

The Moland series consists of well drained, moderately permeable soils on moraines. These soils formed in silty and loamy sediments and underlying friable loamy calcareous till. Slopes range from 1 to 6 percent.

Typical pedon of Moland silt loam, 1 to 6 percent slopes, in Udolpho Township, 980 feet west and 1,150 feet south of the northeast corner of sec. 7, T. 104 N., R. 18 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; medium acid; abrupt smooth boundary.
A—7 to 14 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; neutral; clear smooth boundary.
Bw1—14 to 19 inches; dark brown (10YR 3/3) loam; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.
2Bw2—19 to 36 inches; yellowish brown (10YR 5/4) loam; weak fine subangular blocky structure; friable; 3 percent gravel; neutral; clear smooth boundary.
2Bw3—36 to 45 inches; light olive brown (2.5Y 5/4) loam; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; friable; 3 percent gravel; neutral; clear smooth boundary.
2C—45 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; few medium distinct dark yellowish brown (10YR 4/4) mottles; friable; 3 percent gravel; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 36 to 66 inches. The mollic epipedon is 12 to 19 inches thick. The silty and loamy sediments are 14 to 24 inches thick. The 2Bw and 2C horizons contain 2 to 8 percent coarse fragments.

The A horizon has chroma of 1 or 2. It is silt loam, loam, or silty clay loam.

The Bw horizon has value of 3 to 5 and chroma of 3 or 4. It is silt loam or loam.

The 2Bw horizon has value of 4 or 5 and chroma of 3 or 4. It mainly is clay loam or loam, but a layer up to 5 inches thick of sandy loam or one that is coarser textured is in the upper part of some pedons.

The 2C horizon has value of 4 or 5 and chroma of 2 to 4. It is loam or sandy loam.

Mottland Series

The Mottland series consists of well drained soils on bedrock-controlled uplands. Permeability is moderate in the upper part and moderately rapid in the lower part. The soils formed in glacial drift over soft weathered limestone. Slopes range from 2 to 12 percent.

The Mottland soils in this survey area are outside the defined range of the Mottland series because they have a cambic horizon. This difference does not affect use and management of the Mottland soils.

Typical pedon of Mottland loam, 6 to 12 percent slopes, in Racine Township, 2,250 feet east and 50 feet north of the southwest corner of sec. 36, T. 104 N., R. 14 W.

A—0 to 7 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 3/2) dry; moderate medium subangular blocky structure; friable; about 8 percent coarse fragments; neutral; clear wavy boundary.

Bw—7 to 13 inches; yellowish brown (10YR 5/6) channery loam; moderate fine subangular blocky structure; friable; 20 percent channers of soft weathered limestone; neutral; gradual smooth boundary.

C—13 to 60 inches; yellowish brown (10YR 5/6) channery sandy loam; massive; friable; 30 percent soft weathered limestone channers; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 9 to 16 inches. The solum typically contains 2 to 10 percent coarse fragments of mixed lithology. Some pedons do not have coarse fragments.

The A horizon has value of 2 or 3. It is loam or silt loam.

The Bw horizon has value of 4 or 5 and chroma of 4 to 6.

The C horizon has value of 5 to 7 and chroma of 4 to 8. It is the channery analogs of loam, silt loam, sandy loam, or fine sandy loam. Typically, the C horizon contains 10 to 30 percent soft weathered limestone channers.

Newry Series

The Newry series consists of moderately well drained, moderately permeable soils on moraines. These soils formed in silty sediments and in underlying calcareous till. Slopes range from 1 to 2 percent.

Typical pedon of Newry silt loam, in Lansing Township, 1,500 feet east and 1,400 feet south of the northwest corner of sec. 33, T. 103 N., R. 18 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; weak to moderate very fine granular structure; friable; slightly acid; abrupt wavy boundary.

E—7 to 13 inches; dark grayish brown (10YR 4/2) silt loam, dark brown (10YR 4/3) dry; weak to moderate very fine subangular blocky structure; friable; mixed with very dark grayish brown (10YR 3/2) material; medium acid; clear wavy boundary.

Bt1—13 to 18 inches; dark brown (10YR 4/3) silty clay loam; weak to moderate fine subangular blocky structure; friable; many distinct clay films on faces of peds; medium acid; abrupt wavy boundary.

2Bt2—18 to 24 inches; dark brown (10YR 4/3) loam; few fine distinct dark grayish brown (2.5Y 4/2) mottles; weak to moderate fine subangular blocky structure; friable; common faint dark grayish brown (10YR 4/2) coatings on faces of peds; common distinct clay films on faces of peds; 3 percent gravel; medium acid; clear wavy boundary.

2Bt3—24 to 30 inches; light olive brown (2.5Y 5/4) loam; few fine prominent very dark brown (10YR 2/2) mottles; weak to moderate fine subangular blocky structure; friable; grayish brown (2.5Y 5/2) coatings on faces of peds; many distinct clay films on faces of peds; 3 percent gravel; medium acid; clear wavy boundary.

2Bt4—30 to 38 inches; light olive brown (2.5Y 5/4) loam; few fine distinct grayish brown (2.5Y 5/2) mottles; weak medium subangular blocky structure; friable; few distinct clay films on faces of peds; 3 percent gravel; few distinct sand and silt coatings on faces of peds; medium acid; clear wavy boundary.

2Bt5—38 to 42 inches; brown (10YR 5/3) loam; few fine prominent dark brown (7.5YR 4/4) mottles; weak medium prismatic structure; friable; 3 percent gravel; few clay films on faces of peds; neutral; clear wavy boundary.

2C—42 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; 3 percent gravel; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 40 to 55 inches. The thickness of the silty sediments over loamy friable till ranges from 16 to 24 inches. The 2B and 2C horizons contain 2 to 8 percent coarse fragments.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon is silt loam or loam.

The Bt horizon has value of 4 or 5 and chroma of 3 or 4. It is silty clay loam or silt loam. The 2Bt horizon typically is loam or clay loam, but a layer as much as 5 inches thick of sandy loam or a coarser one is in the upper part of some pedons. The content of mottles in the 2Bt horizon is few or common. The 2C horizon has chroma of 2 to 4.

Nordness Variant

The Nordness Variant consists of well drained, moderately permeable soils on bedrock-controlled uplands. The soils formed in glacial drift and a thin layer of residuum over soft weathered limestone. Slopes range from 2 to 6 percent.

Typical pedon of Nordness Variant loam, 2 to 6 percent slopes, in Le Roy Township, 1,600 feet north and 1,650 feet west of the southeast corner of sec. 27, T. 101 N., R. 14 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; friable; slightly acid; abrupt wavy boundary.

Bt1—7 to 14 inches; yellowish brown (10YR 5/4) clay loam; moderate very fine subangular blocky structure; friable; few faint clay films on faces of peds; slightly acid; abrupt wavy boundary.

2Bt2—14 to 18 inches; dark brown (7.5YR 4/4) clay loam; strong very fine angular blocky structure; friable; few faint clay films on faces of peds; slightly acid; abrupt wavy boundary.

3C1—18 to 26 inches; brownish yellow (10YR 6/6) channery silt loam; massive; friable; 25 percent soft weathered limestone channers; strong effervescence; mildly alkaline.

3C2—26 to 60 inches; brownish yellow (10YR 6/8) channery silt loam; massive; friable; 30 percent soft weathered limestone channers; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 8 to 20 inches.

The A horizon has value of 3 or 4 and chroma of 1 or 2. It mainly is loam, but in places it is silt loam.

The Bt horizon has chroma of 3 or 4. The Bt and 2Bt horizons are loam, silt loam, clay loam, or silty clay loam.

The 3C horizon has hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 4 to 8. It is the channery analogs of silt loam, loam, fine sandy loam, or sandy loam. It contains 20 to 35 percent soft weathered limestone channers.

Oran Series

The Oran series consists of somewhat poorly drained, moderately permeable soils on till plains. These soils formed in loamy sediments and in underlying firm loamy till. Slopes range from 1 to 4 percent.

Typical pedon of Oran silt loam, 1 to 4 percent slopes, in Adams Township, 600 feet east and 50 feet north of the southwest corner of sec. 26, T. 101 N., R. 16 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, grayish brown (2.5Y 5/2) dry; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

E—8 to 14 inches; dark grayish brown (10YR 4/2) silt loam; weak fine subangular blocky structure; friable; medium acid; abrupt smooth boundary.

BE—14 to 21 inches; dark grayish brown (10YR 4/2) silt loam; weak fine subangular blocky structure; friable; strongly acid; clear wavy boundary.

2Bt1—21 to 27 inches; grayish brown (2.5Y 5/2) loam; few fine distinct dark grayish brown (10YR 4/2) mottles; weak fine and medium subangular blocky structure; friable; 3 percent gravel; strongly acid; clear wavy boundary.

2Bt2—27 to 40 inches; dark yellowish brown (10YR 4/4) loam; common fine distinct grayish brown (2.5Y 5/2) mottles; moderate subangular blocky structure; friable; 3 percent gravel; few distinct sand and silt coatings on faces of peds; strongly acid; clear wavy boundary.

2Bt3—40 to 48 inches; dark yellowish brown (10YR 4/4) loam; many fine distinct grayish brown (2.5Y 5/2) mottles; moderate coarse prismatic structure; firm; 3 percent gravel; few distinct sand and silt coatings on faces of peds; medium acid; clear wavy boundary.

2C—48 to 60 inches; yellowish brown (10YR 5/6) loam; many fine distinct grayish brown (2.5Y 5/2) mottles; massive; firm; 3 percent gravel; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 40 to 70 inches. The thickness of the silty and loamy sediments ranges from 14 to 24 inches. The 2B and 2C horizons contain 2 to 8 percent coarse fragments.

The A horizon has value of 2 or 3 and chroma of 1 or 2.

The E and BE horizons have value of 4 or 5 and chroma of 2 or 3. They are loam or silt loam.

The 2Bt horizon has chroma of 2 to 8. It mainly is loam, clay loam, or sandy clay loam. A layer as much as 5 inches thick of sandy loam or a coarser one is in the upper part of some pedons.

The 2C horizon has value of 4 or 5 and chroma of 4 to 6.

Ostrander Series

The Ostrander series consists of well drained, moderately permeable soils on till plains. The soils formed in silty and loamy sediments and underlying friable and firm till. Slopes range from 0 to 6 percent.

Typical pedon of Ostrander loam, 2 to 6 percent slopes, in Red Rock Township, 2,340 feet east and 1,240 feet north of the southwest corner of sec. 10, T. 103 N., R. 17 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

A—8 to 12 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; moderate fine subangular blocky structure; friable; slightly acid; clear wavy boundary.

AB—12 to 16 inches; dark brown (10YR 3/3) loam, brown (10YR 4/3) dry; moderate fine subangular blocky structure; very dark grayish brown (10YR 3/2) coatings on faces of peds; friable; slightly acid; clear wavy boundary.

Bw1—16 to 20 inches; brown (10YR 4/3) silt loam; moderate fine and medium subangular blocky structure; friable; medium acid; abrupt wavy boundary.

2Bw2—20 to 24 inches; dark yellowish brown (10YR 4/4) loam; moderate fine and medium subangular blocky structure; friable; thin stone line in upper part; 2 percent gravel in lower part; strongly acid; clear wavy boundary.

2Bw3—24 to 30 inches; dark yellowish brown (10YR 4/4) sandy clay loam; moderate medium and coarse subangular blocky structure; friable; 3 percent gravel; strongly acid; clear wavy boundary.

2Bw4—30 to 38 inches; yellowish brown (10YR 5/6) sandy clay loam; moderate fine and medium prismatic structure; friable; 3 percent gravel; strongly acid; clear wavy boundary.

2BC—38 to 50 inches; yellowish brown (10YR 5/6) sandy clay loam; common fine distinct pale brown (10YR 6/3) mottles; moderate medium and coarse prismatic structure; friable; 3 percent gravel; slightly acid; clear wavy boundary.

3C—50 to 60 inches; yellowish brown (10YR 5/6) loam; common fine distinct grayish brown (10YR 5/2) and common fine faint yellowish brown (10YR 5/8) mottles; massive with some horizontal cleavage; firm; 3 percent gravel; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 44 to 70 inches. The thickness of the silty and loamy sediments ranges from 14 to 24 inches. The silty and loamy sediments typically contain less than 2 percent coarse fragments, mostly pebble-size. The underlying loamy drift and loamy till typically have 2 to 6 percent gravel, mostly pebble-size. In places one or more stone lines with as much as 30 percent pebbles and cobbles separate the silty and loamy sediments from the underlying friable loamy drift and firm loamy till.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is typically loam, but in some pedons it is silt loam, clay loam, or silty clay loam.

The Bw horizon has value and chroma of 3 or 4. It is loam or silt loam.

The 2Bw horizon has chroma of 4 to 8. It is sandy clay loam or loam.

The 3C horizon has chroma of 3 to 6.

Palms Series

The Palms series consists of very poorly drained, moderately and moderately slowly permeable soils in depressions on moraines, outwash plains, and stream terraces. The soils formed in well decomposed organic soil material over loamy sediments. Slopes range from 0 to 2 percent.

Typical pedon of Palms muck, in Lansing Township, 2,640 feet east and 1,980 feet north of the southwest corner of sec. 19, T. 103 N., R. 18 W.

Oap—0 to 10 inches; black (10YR 2/1) muck, black (10YR 2/1) dry; about 15 percent fiber, about 5 percent rubbed; weak fine subangular blocky structure; very friable; about 35 percent mineral material; herbaceous fiber; neutral; abrupt smooth boundary.

Oa1—10 to 22 inches; black (10YR 2/1) sapric material, black (10YR 2/1) dry; about 10 percent fiber, about 5 percent rubbed; moderate medium platy structure; very friable; about 35 percent mineral material; neutral; clear wavy boundary.

Oa2—22 to 32 inches; black (10YR 2/1) sapric material, black (10YR 2/1) dry; moderate medium platy structure; very friable; neutral; clear wavy boundary.

Cg1—32 to 40 inches; olive gray (5Y 4/2) clay loam; few fine distinct dark yellowish brown (10YR 3/4) mottles; weak coarse subangular blocky structure; friable; few dark brown (10YR 3/3) fillings in root channels; neutral; clear wavy boundary.

Cg2—40 to 60 inches; dark gray (5Y 4/1) silty clay loam; few fine distinct dark yellowish brown (10YR 4/4) mottles; massive; friable; slight effervescence; moderately alkaline.

The thickness of the organic soil material is 16 to 50 inches. The organic soil material typically is sapric. The sapric material typically has about 10 percent fiber, but in a few pedons it has as much as 35 percent fiber in the unrubbed condition. It has 25 to 80 percent mineral material. A thin layer of hemic or coprogenous earth or both is in some pedons at a depth of more than 16 inches. The underlying mineral soil is clay loam, silty clay loam, silt loam, or loam.

Protivin Series

The Protivin series consists of somewhat poorly drained, moderately slowly permeable soils on till plains. These soils formed in loamy sediments and in underlying very firm loamy till. Slopes range from 1 to 3 percent.

Typical pedon of Protivin silt loam, in Grand Meadow Township, 750 feet east and 60 feet north of the southwest corner of sec. 24, T. 103 N., R. 15 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, very dark brown (10YR 2/2) dry; weak very fine granular structure; friable; neutral; abrupt wavy boundary.

A—9 to 13 inches; black (10YR 2/1) silt loam, very dark brown (10YR 2/2) dry; moderate fine subangular structure parting to moderate very fine granular; friable; neutral; abrupt wavy boundary.

BA—13 to 20 inches; olive brown (2.5Y 4/4) clay loam; common fine prominent yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; friable; common distinct very dark grayish brown (10YR 3/2) coatings on faces of peds; medium acid; abrupt wavy boundary.

2Bt1—20 to 30 inches; brown (10YR 5/3) clay loam; strong fine angular blocky structure; very firm; few distinct gray (10YR 5/1) coatings on faces of peds; few distinct very dark gray (10YR 3/1) clay films on faces of peds; 3 percent gravel; medium acid; clear wavy boundary.

2Bt2—30 to 40 inches; brown (10YR 5/3) clay loam; strong fine and medium prismatic structure; very firm; few distinct gray (10YR 5/2) coatings on faces of peds; few distinct very dark gray (10YR 3/1) clay films on faces of peds; 3 percent gravel; slightly acid; abrupt wavy boundary.

2C—40 to 60 inches; brown (10YR 5/3) clay loam; common coarse prominent gray (5Y 5/1) mottles; massive; firm; 3 percent gravel; neutral.

The thickness of the solum and the depth to free carbonates range from 36 to 66 inches. The mollic epipedon is 12 to 18 inches thick. The loamy sediment is 14 to 24 inches thick. The volume of coarse fragments ranges from 0 to 2 percent in the loamy sediment and 2 to 8 percent in the loamy till.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is typically silt loam, but in some pedons loam and clay loam are within the range.

The 2Bt horizon has chroma of 1 to 6. It has none to many mottles. It mainly is clay loam, but a layer as much as 5 inches thick of sandy loam or a coarser one is in the upper part of some pedons.

The 2C horizon has value of 4 or 5 and chroma of 2 to 5.

Racine Series

The Racine series consists of well drained, moderately permeable soils on till plains. These soils formed in silty and loamy sediments and underlying firm loamy till. Slopes range from 0 to 12 percent.

Typical pedon of Racine silt loam, 2 to 6 percent slopes, in Frankford Township, 650 feet west and 50 feet south of the northeast corner of sec. 3, T. 103 N., R. 14 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) dry; weak very fine granular structure; friable; neutral; abrupt wavy boundary.

E—8 to 13 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; weak medium platy structure; friable; very dark brown (10YR 2/2) sand and silt coatings on faces of peds; slightly acid; clear wavy boundary.

Bt1—13 to 20 inches; dark brown (10YR 4/3) silt loam; weak very fine subangular blocky structure; friable; common distinct sand and silt coatings on faces of peds; few distinct clay films on faces of peds; medium acid; abrupt wavy boundary.

2Bt2—20 to 35 inches; yellowish brown (10YR 5/4) loam; moderate fine subangular blocky structure; friable; 3 percent gravel; few distinct continuous clay films; medium acid; clear wavy boundary.

2BC—35 to 45 inches; yellowish brown (10YR 5/4) loam; weak medium prismatic structure; firm; 3 percent gravel; few faint clay films on faces of peds; medium acid; clear wavy boundary.

2C—45 to 60 inches; yellowish brown (10YR 5/4) loam; massive; firm; 3 percent gravel; common fine soft masses of lime; strong effervescence; mildly alkaline.

The thickness of the solum is 36 to 64 inches. The depth to free carbonates ranges from 40 to 70 inches. The thickness of the silty and loamy sediments over friable loamy drift and firm loamy till ranges from 14 to 24 inches. A sandy or coarse-loamy layer as much as 5 inches thick with as much as 15 percent coarse fragments commonly separates the till from the upper sediments. The underlying loamy till contains 2 to 10 percent coarse fragments.

The A horizon has value of 2 or 3 and chroma of 1 or 2.

The E horizon has chroma of 2 or 3.

The Bt horizon has chroma of 3 or 4. It is silt loam, loam, silty clay loam, or clay loam. Low-chroma mottles are in some pedons at a depth of as little as 36 inches.

The 2Bt horizon has value of 4 or 5 and chroma of 4 to 6. It is sandy clay loam, loam, or clay loam. It has few to many thin to thick clay films.

The 2C horizon has chroma of 3 to 8.

Readlyn Series

The Readlyn series consists of somewhat poorly drained, moderately permeable soils on till plains. These soils formed in silty and loamy sediments and underlying firm loamy till. Slopes range from 1 to 3 percent.

Typical pedon of Readlyn silt loam, in Red Rock Township, 200 feet south and 2,500 feet east of the northwest corner of sec. 1, T. 103 N., R. 17 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, very dark brown (10YR 2/2) dry; weak fine granular structure; friable; medium acid; abrupt smooth boundary.

A1—8 to 13 inches; black (10YR 2/1) silt loam, very dark brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; medium acid; gradual wavy boundary.

A2—13 to 17 inches; very dark grayish brown (10YR 3/2) silt loam, dark brown (10YR 3/3) dry; weak fine subangular blocky structure; friable; medium acid; gradual wavy boundary.

Bw1—17 to 22 inches; dark brown (10YR 4/3) silt loam; few fine faint dark grayish brown (10YR 4/2) mottles; weak medium prismatic structure parting to weak fine subangular blocky; friable; medium acid; gradual wavy boundary.

2Bw2—22 to 28 inches; dark yellowish brown (10YR 4/4) loam; common fine distinct dark grayish brown (2.5Y 4/2) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; 3 percent gravel; medium acid; gradual wavy boundary.

2Bw3—28 to 40 inches; yellowish brown (10YR 5/4) loam; common fine distinct dark grayish brown (2.5Y 4/2) mottles; moderate medium and coarse prismatic structure parting to moderate medium subangular blocky; firm; 3 percent gravel; few thin discontinuous clay films; medium acid; gradual wavy boundary.

2Bw4—40 to 47 inches; yellowish brown (10YR 5/6) loam; common fine distinct dark grayish brown (2.5Y 4/2) mottles; moderate medium prismatic structure; firm; 3 percent gravel; slightly acid; gradual wavy boundary.

2C—47 to 60 inches; yellowish brown (10YR 5/6) loam; common fine distinct grayish brown (2.5Y 5/2) mottles; massive; firm; 3 percent gravel; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 40 to 60 inches. The mollic epipedon is 16 to 20 inches thick. The silty and loamy sediments are 14 to 24 inches thick. The volume of coarse fragments in the 2Bw and 2C horizons ranges from 2 to 8 percent.

The A horizon is typically silt loam, but in some pedons it is loam or silty clay loam.

The Bw horizon has value of 4 or 5 and chroma of 3 or 4. It is loam or silt loam.

The 2Bw horizon has chroma of 2 to 6. It has few to many mottles. It mainly is clay loam or loam, but a layer as much as 5 inches thick of sandy loam or a coarser textured one is in the upper part in some pedons.

The 2C horizon has chroma of 3 to 8.

Riceville Series

The Riceville series consists of somewhat poorly drained, moderately slowly permeable soils on till plains. These soils formed in loamy sediments and in underlying very firm loamy till. Slopes range from 1 to 3 percent.

Typical pedon of Riceville silt loam, in Le Roy

Township, 2,500 feet east and 150 feet south of the northwest corner of sec. 35, T. 101 N., R. 14 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak very fine granular structure; friable; strongly acid; abrupt smooth boundary.

E—7 to 11 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; few fine faint dark brown (10YR 4/3) mottles; moderate thin platy structure; friable; very strongly acid; abrupt wavy boundary.

Bt1—11 to 17 inches; dark grayish brown (2.5Y 4/2) and brown (10YR 4/3) loam; common fine prominent yellowish brown (10YR 5/4) mottles; moderate fine subangular blocky structure; friable; few distinct grayish brown (10YR 5/2) sand and silt coatings on faces of peds; very strongly acid; abrupt wavy boundary.

2Bt2—17 to 21 inches; yellowish brown (10YR 5/6) clay loam; few fine distinct gray (5Y 5/1) mottles; few medium prominent strong brown (7.5YR 5/8) mottles; moderate fine angular blocky structure; firm; 3 percent gravel; many prominent light gray (10YR 7/1) sand and silt coatings on faces of peds; very strongly acid; abrupt wavy boundary.

2Bt3—21 to 30 inches; yellowish brown (10YR 5/6) clay loam; few medium prominent gray (5Y 5/1) mottles; many medium distinct strong brown (7.5YR 5/8) mottles; strong fine and medium angular blocky structure; very firm; 3 percent gravel; many prominent sand and silt coatings of light gray (10YR 7/1) on faces of peds; few clay films; strongly acid; clear wavy boundary.

2Bt4—30 to 40 inches; yellowish brown (10YR 5/6) clay loam; few fine prominent gray (5Y 5/1) mottles; many medium distinct yellowish brown (10YR 5/4) mottles; strong fine and medium prismatic structure; very firm; 3 percent gravel; few distinct light gray (10YR 7/1) sand and silt coatings on faces of peds; few distinct clay films; medium acid; clear wavy boundary.

2C—40 to 60 inches; yellowish brown (10YR 5/8) clay loam; many coarse distinct yellowish brown (10YR 5/4) mottles; weak coarse prismatic structure; firm to very firm; few gray (10YR 5/1) coatings on faces of peds; 3 percent gravel; slight effervescence; mildly alkaline.

The thickness of the solum is at least 40 inches. The loamy sediment is 16 to 24 inches thick. The volume of coarse fragments ranges from 2 to 6 percent in the 2Bt and 2C horizons.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It typically is silt loam, but in some pedons it is loam.

The E horizon has value of 4 or 5. Mottles range from few to many and faint to prominent.

The Bt horizon has chroma of 2 or 3. Mottles range from few to many and faint to prominent. It is loam or clay loam.

The 2Bt horizon has value of 5 or 6 and chroma of 1 to 8. It ranges from 30 to 35 percent clay. In the upper part of some pedons it has a layer as much as 5 inches thick of sandy loam or a coarser textured one.

The 2C horizon has value of 4 or 5 and chroma of 4 to 8.

Rossfield Series

The Rossfield series consists of well drained soils on bedrock-controlled uplands. Permeability is moderate in the upper part and moderately rapid in the lower part. The soils formed in glacial drift over soft weathered limestone. Slopes range from 0 to 6 percent.

Typical pedon of Rossfield silt loam, 0 to 2 percent slopes, in Bennington Township, 2,300 feet east and 75 feet north of the southwest corner of sec. 12, T. 102 N., R. 14 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) dry; weak very fine granular structure; friable; 2 percent gravel; slightly acid; abrupt smooth boundary.

A—8 to 15 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) dry; moderate fine granular structure; friable; 2 percent gravel; slightly acid; clear wavy boundary.

Bw1—15 to 21 inches; brown (10YR 4/3) loam; moderate fine subangular blocky structure; friable; dark brown (10YR 3/3) coatings on faces of peds; 3 percent gravel; slightly acid; clear wavy boundary.

Bw2—21 to 29 inches; yellowish brown (10YR 5/4) loam; weak medium subangular blocky structure; friable; brown (10YR 4/3) coatings on faces of peds; 5 percent gravel; neutral; clear smooth boundary.

2C1—29 to 54 inches; brownish yellow (10YR 6/6) channery loam; massive; friable; 20 percent soft weathered limestone channers; slight effervescence; mildly alkaline; gradual wavy boundary.

2C2—54 to 60 inches; brownish yellow (10YR 6/8) channery sandy loam; massive; friable; 30 percent soft weathered limestone channers; strong effervescence; mildly alkaline.

The solum thickness ranges from 20 to 40 inches. The solum typically contains 2 to 6 percent coarse fragments, but in some pedons there are no coarse fragments.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is typically silt loam, but in some pedons it is loam.

The Bw horizon has chroma of 3 to 6. It is loam, clay loam, or silty clay loam.

The 2C horizon is the channery analogs of loam, sandy loam, or fine sandy loam.

Sargeant Series

The Sargeant series consists of somewhat poorly drained soils on till plains. Permeability is moderate in the upper part and slow in the lower part. The soils formed in silty sediments and underlying firm loamy till. Slopes range from 0 to 3 percent.

Typical pedon of Sargeant silt loam, in Austin Township, 1,400 feet west and 500 feet north of the southeast corner of sec. 36, T. 102 N., R. 18 W.

Ap—0 to 8 inches; dark gray (10YR 4/1) silt loam, gray (10YR 6/1) dry; weak very fine and fine granular structure; friable; slightly acid; abrupt smooth boundary.

E—8 to 12 inches; light brownish gray (10YR 6/2) silt loam, light gray (10YR 7/1) dry; common medium faint dark yellowish brown (10YR 4/4) mottles; moderate platy structure; friable; medium acid; clear wavy boundary.

E/B—12 to 22 inches; grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) silt loam (E), light gray (10YR 7/1) dry; surrounding and tonguing into brown (10YR 5/3) and yellowish brown (10YR 5/6) silt loam (Bt); moderate very fine subangular blocky structure; friable; common distinct clay films on faces of peds; strongly acid; abrupt wavy boundary.

2B/E—22 to 28 inches; yellowish brown (10YR 5/4) sandy loam (Bt); many medium distinct grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; friable; common distinct light brownish gray (10YR 6/2) sand and silt coatings on faces of peds (E); 3 percent gravel; strongly acid; abrupt wavy boundary.

2Bt—28 to 45 inches; yellowish brown (10YR 5/6) loam; many medium distinct grayish brown (10YR 5/2) mottles; moderate coarse prismatic structure; firm; common prominent gray (5Y 6/1) sand and silt coatings on faces of peds; thin continuous clay films on faces of peds; 3 percent gravel; medium acid; clear wavy boundary.

2C—45 to 60 inches; yellowish brown (10YR 5/6) loam; many coarse prominent pale olive (5Y 6/3) mottles; massive; firm; light olive gray (5Y 6/2) coatings on faces of peds; 3 percent gravel; slightly acid.

The thickness of the solum and the depth to free carbonates are at least 38 inches. The silty sediments are 12 to 22 inches thick. The volume of coarse fragments ranges from 2 to 8 percent in the 2Bt and 2C horizons and is as much as 20 percent in thin pebble bands separating the silty sediments and the loamy till.

The A horizon has value of 2 to 4 and chroma of 1 or 2. It is typically silt loam, but in some pedons it is loam.

The E horizon has value of 4 to 6 and chroma of 1 or 2. Mottles range from few to many and faint to prominent. It is loam or silt loam. The B part of the E/B horizon in the loess has value of 4 or 5 and chroma of 2 to 4. Mottles range from few to many and faint to prominent. It is silt loam or silty clay loam.

The 2Bt horizon has value of 4 or 5 and chroma of 4 to 6. It has faint to prominent mottles. A subhorizon as much as 5 inches thick of sandy loam or a coarser textured one is in the upper part in some pedons.

The 2C horizon has value of 4 or 5 and chroma of 5 or 6. It is sandy clay loam or loam.

Sargeant Variant

The Sargeant Variant consists of somewhat poorly drained soils in low positions on bedrock-controlled uplands. Permeability is moderate or moderately slow in the upper part and very slow in the lower part. The soils formed in silty and loamy sediments and underlying firm clay. Slopes range from 0 to 2 percent.

Typical pedon of Sargeant Variant silt loam, in Austin Township, 2,450 feet north and 750 feet east of the southwest corner of sec. 13, T. 102 N., R. 18 W.

A—0 to 9 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; firm; slightly acid; abrupt smooth boundary.

E—9 to 14 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; common medium distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; common very dark brown (10YR 2/2) worm casts in channels; strongly acid; abrupt wavy boundary.

Bt1—14 to 21 inches; grayish brown (10YR 5/2) loam;

many medium faint yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; friable; few dark brown (7.5YR 3/2) clay films in channels; very strongly acid; clear wavy boundary.

Bt2—21 to 25 inches; grayish brown (10YR 5/2) clay loam; many coarse faint yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; friable; common dark brown (7.5YR 3/2) clay films on faces of peds; 4 percent limestone fragments; very strongly acid; clear wavy boundary.

Bt3—25 to 32 inches; brown (10YR 5/3) sandy clay loam; many coarse faint grayish brown (10YR 5/2) mottles; moderate fine prismatic structure; friable; common dark yellowish brown (10YR 4/4) clay films on ped exteriors; 4 percent limestone fragments; very strongly acid; abrupt wavy boundary.

2Bt4—32 to 40 inches; yellowish brown (10YR 5/8) clay; moderate medium subangular blocky structure; extremely firm; few dark brown (7.5YR 3/2) clay films on channels; 3 percent limestone fragments; slightly acid; clear wavy boundary.

2C—40 to 60 inches; yellowish brown (10YR 5/8) clay; massive; extremely firm; 3 percent limestone fragments; slightly acid.

The solum thickness ranges from 30 to 50 inches. The depth to the contrasting clay ranges from 20 to 36 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is typically silt loam, but in some pedons it is loam.

The E horizon has value of 4 to 6 and chroma of 1 or 2. It is loam or silt loam.

The Bt horizon has value of 4 or 5 and chroma of 1 to 4. Mottles with chroma of 1 or 2 range from few to many in all parts of the Bt horizon. The horizon is typically loam, clay loam, or sandy clay loam, but subhorizons of silty material up to 6 inches thick are in some pedons. The 2Bt and 2C horizons have hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 4 to 8.

Sawmill Series

The Sawmill series consists of poorly drained, moderately permeable soils on flood plains. The soils formed in recent alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Sawmill silty clay loam, in Le Roy Township, 2,050 feet west and 2,350 feet south of the northeast corner of sec. 35, T. 101 N., R. 14 W.

Ap—0 to 10 inches; very dark brown (10YR 2/2) silty clay loam, very dark brown (10YR 2/2) dry; moderate very fine granular structure; friable; slightly acid; abrupt wavy boundary.

A1—10 to 14 inches; very dark gray (10YR 3/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate very fine granular structure; friable; slightly acid; abrupt wavy boundary.

A2—14 to 20 inches; very dark gray (10YR 3/1) silty clay loam, very dark gray (10YR 3/1) dry; many medium distinct dark brown (7.5YR 3/2) mottles; strong very fine granular structure; friable; slightly acid; abrupt wavy boundary.

AB—20 to 29 inches; very dark gray (10YR 3/1) silty clay loam; strong very fine angular blocky structure; friable; slightly acid; clear wavy boundary.

Bg—29 to 36 inches; dark gray (10YR 4/1) silty clay loam; many coarse prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; slightly acid; abrupt wavy boundary.

Cg—36 to 60 inches; gray (5Y 5/1) silty clay loam; massive; firm; neutral; abrupt wavy boundary.

The thickness of the solum ranges from 36 to 54 inches. The thickness of the mollic epipedon ranges from 24 to 36 inches.

The Bg horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2. It is silty clay loam, silt loam, or clay loam.

The Cg horizon has hue of 5Y or 2.5Y, value of 4 to 6, and chroma of 1 to 3. It is silty clay loam or silt loam.

Schley Series

The Schley series consists of somewhat poorly drained, moderately permeable soils on till plains. These soils formed in silty and loamy sediments and underlying loamy drift and firm loamy till. Slopes range from 0 to 3 percent.

Typical pedon of Schley silt loam, in Lyle Township, 2,350 feet south and 150 feet west of the northeast corner of sec. 7, T. 101 N., R. 18 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, gray (10YR 5/1) dry; moderate very fine granular structure; friable; slightly acid; abrupt smooth boundary.

E—8 to 13 inches; grayish brown (10YR 5/2) silt loam, pale brown (10YR 6/3) dry; common fine faint gray (10YR 5/1) mottles; moderate very thin platy structure; friable; very strongly acid; abrupt wavy boundary.

BE—13 to 19 inches; grayish brown (10YR 5/2) silt loam; common medium distinct yellowish brown (10YR 5/4) mottles; moderate fine subangular blocky structure; friable; very strongly acid; abrupt wavy boundary.

Bt1—19 to 28 inches; brown (7.5YR 5/2 and 5/3) sandy loam; common coarse distinct yellowish brown (10YR 5/4) mottles; moderate fine and medium subangular blocky structure; friable; many prominent gray (5Y 6/1) sand and silt coatings on faces of peds; thin distinct clay films on faces of peds; 4 percent gravel; very strongly acid; abrupt wavy boundary.

2Bt2—28 to 40 inches; strong brown (7.5YR 5/6) and yellowish brown (10YR 5/4) sandy clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate fine and medium prismatic structure; friable; thin distinct clay films on faces of peds; 4 percent gravel; strongly acid; clear wavy boundary.

2C—40 to 60 inches; brown (7.5YR 5/4) sandy clay loam; many coarse distinct strong brown (7.5YR 5/6) mottles; massive; firm; 6 percent gravel, 2 percent cobbles; medium acid; clear wavy boundary.

The thickness of the solum ranges from 40 to 60 inches. The volume of coarse fragments ranges from 2 to 6 percent in the 2Bt and 2C horizons.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has value of 4 or 5. Mottles range from few to many and faint to prominent.

The Bt horizon has hue of 2.5Y, 10YR, or 7.5YR, value of 4 or 5, and chroma of 2 to 6. Mottles range from few to many and faint to prominent. It is silt loam, sandy loam, or sandy clay loam.

The 2Bt horizon has hue of 7.5YR or 2.5Y. It is loam, sandy clay loam, or clay loam.

The 2C horizon has hue of 2.5Y, 10YR, or 7.5YR, value of 4 or 5, and chroma of 4 to 6.

Shandep Series

The Shandep series consists of very poorly drained soils on outwash plains and stream terraces. Permeability is moderate in the upper part and rapid in the lower part. The soils formed in loamy sediments and sandy and gravelly underlying materials. Slopes are 0 to 1 percent.

Typical pedon of Shandep clay loam, in Austin Township, 100 feet north and 2,500 feet west of the southeast corner of sec. 9, T. 102 N., R. 18 W.

Ap—0 to 9 inches; black (N 2/0) clay loam, black (N 2/0) dry; massive; friable; slightly sticky; 3 percent gravel; neutral; abrupt wavy boundary.

A1—9 to 15 inches; black (N 2/0) clay loam, black (N 2/0) dry; weak fine and medium subangular blocky structure; friable; slightly sticky; 3 percent gravel; neutral; gradual irregular boundary.

A2—15 to 21 inches; black (5Y 2/1) clay loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; friable; slightly sticky; 3 percent gravel; neutral; clear wavy boundary.

AB—21 to 29 inches; very dark gray (5Y 3/1) clay loam; weak fine and medium subangular blocky structure; friable; slightly sticky; 5 percent gravel; neutral; clear wavy boundary.

Bg—29 to 36 inches; dark gray (5Y 4/1) loam; common fine distinct olive (5Y 4/3) mottles; weak fine and medium subangular blocky structure; friable; slightly sticky; 5 percent gravel; neutral; clear wavy boundary.

BCg—36 to 42 inches; gray (5Y 4/1) sandy loam; massive; very friable; 5 percent gravel; neutral; clear wavy boundary.

2C1—42 to 50 inches; dark grayish brown (10YR 4/2) coarse sand; single grained; loose; 12 percent gravel; neutral; abrupt wavy boundary.

2C2—50 to 60 inches; grayish brown (2.5Y 5/2) gravelly coarse sand; single grained; loose; 18 percent gravel; neutral.

The thickness of the solum ranges from 40 to 55 inches. The volume of coarse fragments ranges from 0 to 30 percent.

The A horizon has value of 2 or 3. It is typically clay loam, but in some pedons it is loam or silty clay loam.

The Bg horizon has hue of 5Y or is neutral, has value of 4 or 5, and has chroma of 0 or 1. It is clay loam, loam, or silty clay loam.

The 2C horizon is coarse sand, loamy sand, gravelly coarse sand, gravelly loamy coarse sand, or gravelly loamy sand.

Skyberg Series

The Skyberg series consists of somewhat poorly drained soils on till plains. Permeability is moderate in the upper part and moderately slow in the lower part. These soils formed in silty sediments and in underlying firm loamy till. Slopes range from 0 to 2 percent.

Typical pedon of Skyberg silt loam, in Bennington Township, 1,780 feet east and 75 feet north of the southwest corner of sec. 8, T. 102 N., R. 14 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, gray

(10YR 5/1) dry; weak very fine granular structure; friable; slightly acid; abrupt wavy boundary.

E—8 to 12 inches; dark grayish brown (10YR 4/2) silt loam, light gray (10YR 7/1) dry; few fine faint brown (10YR 4/3) mottles; weak thin platy structure; friable; dark gray (10YR 4/1) coatings on faces of peds; medium acid; abrupt wavy boundary.

Btg1—12 to 21 inches; grayish brown (10YR 5/2) silty clay loam; few fine distinct yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; friable; common distinct clay films on faces of peds; strongly acid; abrupt wavy boundary.

2Btg2—21 to 32 inches; yellowish brown (10YR 5/6) loam; many fine prominent grayish brown (2.5Y 5/2) mottles; moderate very fine subangular blocky structure; friable; grayish brown (10YR 5/2) coatings on faces of peds; few distinct clay films on faces of peds; 3 percent gravel; medium acid; gradual wavy boundary.

2Bt1—32 to 40 inches; yellowish brown (10YR 5/4) loam; many fine prominent grayish brown (2.5Y 5/2) mottles; weak medium prismatic structure; firm; few distinct clay films on faces of peds; 3 percent gravel; medium acid; gradual wavy boundary.

2Bt2—40 to 50 inches; yellowish brown (10YR 5/6) loam; many fine prominent grayish brown (2.5Y 5/2) mottles; weak medium subangular blocky structure; firm; few faint clay films on faces of peds; 3 percent gravel; medium acid; gradual wavy boundary.

2C—50 to 60 inches; yellowish brown (10YR 5/6) loam; many fine prominent grayish brown (2.5Y 5/2) mottles; massive; firm; 3 percent gravel; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates are at least 42 inches. The silty sediments are 16 to 24 inches thick. The volume of coarse fragments in the 2Bt and 2C horizons ranges from 2 to 8 percent.

The A horizon has value of 2 or 3. The E horizon has value of 4 or 5 and chroma of 1 or 2. Mottles range from few to many and faint to prominent. The Btg horizon has value of 4 or 5. Mottles range from few to many and faint to prominent. The horizon is silt loam or silty clay loam. A subhorizon of sandy loam or coarser texture as much as 5 inches thick is in the upper part in some pedons. The 2C horizon has chroma of 4 to 8.

Spillville Series

The Spillville series consists of moderately well drained, moderately permeable soils on flood plains. The soils formed in recent alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Spillville loam, occasionally flooded, in Le Roy Township, 1,500 feet east and 1,400 feet north of the southwest corner of sec. 35, T. 101 N., R. 14 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) loam, very dark brown (10YR 2/2) dry; weak very fine granular structure; friable; slightly acid; abrupt wavy boundary.

A1—9 to 24 inches; black (10YR 2/1) loam, very dark brown (10YR 2/2) dry; weak very fine subangular blocky structure; friable; slightly acid; clear wavy boundary.

A2—24 to 30 inches; very dark brown (10YR 2/2) loam, very dark brown (10YR 2/2) dry; moderate very fine prismatic structure parting to moderate very fine subangular blocky; friable; few sand and silt coatings on faces of peds; neutral; clear wavy boundary.

A3—30 to 44 inches; very dark grayish brown (10YR 3/2) loam, very dark grayish brown (10YR 3/2) dry; moderate fine prismatic structure parting to moderate fine subangular blocky; friable; few sand and silt coatings on faces of peds; neutral; clear wavy boundary.

A4—44 to 52 inches; very dark grayish brown (10YR 3/2) loam; moderate fine and medium prismatic structure; friable; few sand and silt coatings on faces of peds; slightly acid; clear wavy boundary.

C—52 to 60 inches; very dark grayish brown (10YR 3/2) sandy loam; massive; friable; neutral.

The thickness of the solum ranges from 30 to 56 inches.

The A horizon is typically loam, but in some pedons it is silt loam.

Stateline Series

The Stateline series consists of poorly drained, very slowly permeable soils on till plains. These soils formed in loamy and silty sediments and in underlying very firm clayey paleosols. Slopes range from 0 to 2 percent.

Typical pedon of Stateline silt loam, in Nevada Township, 2,100 feet east and 550 feet south of the northwest corner of sec. 7, T. 101 N., R. 17 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

E1—7 to 10 inches; dark grayish brown (2.5Y 4/2) silty clay loam, light gray (10YR 7/1) dry; many fine prominent yellowish brown (10YR 5/8) mottles; moderate thin platy structure; friable; very strongly acid; abrupt wavy boundary.

E2—10 to 14 inches; dark grayish brown (2.5Y 4/2) clay loam, light gray (10YR 7/1) dry; many fine prominent yellowish brown (10YR 5/8) mottles; moderate thin platy structure; friable; very strongly acid; clear wavy boundary.

BE—14 to 18 inches; dark grayish brown (2.5Y 4/2) silty clay loam; many fine prominent yellowish brown (10YR 5/8) mottles; weak coarse prismatic structure parting to strong fine subangular blocky; firm; many distinct clear sand and silty grains on faces of peds; common distinct clay films on faces of peds; very strongly acid; clear wavy boundary.

2Btg1—18 to 24 inches; olive gray (5Y 5/2) silty clay; common coarse prominent grayish brown (10YR 5/2) mottles; strong medium prismatic structure parting to strong fine subangular blocky; firm; many distinct clear sand and silt grains coating faces of peds; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; strongly acid; clear wavy boundary.

2Btg2—24 to 36 inches; dark gray (10YR 4/1) clay; common coarse faint strong grayish brown (10YR 5/2) mottles; medium and coarse prismatic structure parting to strong fine subangular blocky; very firm; many distinct clear sand and silt grains on faces of peds; many fine clay films on faces of peds; strongly acid; abrupt wavy boundary.

2Btg3—36 to 60 inches; grayish brown (10YR 5/2) clay; common medium prominent olive (5Y 5/4) mottles; strong coarse prismatic structure; very firm; strongly acid.

The thickness of the solum is at least 40 inches, and the depth to free carbonates is more than 60 inches. The loamy and silty sediments are 18 to 30 inches thick. Some pedons have pebble bands with as much as 10 percent gravel between the materials.

The A horizon has chroma of 1 or 2. It is loam or silt loam. The E horizon has value of 4 or 5. It is silty clay loam or clay loam. Some pedons have a Bt horizon that has value of 4 or 5 and chroma of 2. Mottles range from few to many and faint to prominent. The 2Btg horizon is silty clay or clay.

Taopi Series

The Taopi series consists of well drained, moderately permeable soils on bedrock-controlled uplands. The soils formed in glacial drift and a thin layer of residuum over soft weathered limestone. Slopes range from 1 to 12 percent.

Typical pedon of Taopi silt loam, 1 to 6 percent slopes, in Racine Township, 1,300 feet north and 2,050 feet east of the southwest corner of sec. 2, T. 103 N., R. 14 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; friable; about 2 percent coarse fragments; medium acid; abrupt smooth boundary.

BE—7 to 11 inches; dark brown (10YR 4/3) silt loam; moderate very fine subangular blocky structure; friable; about 2 percent coarse fragments; common thin grayish brown (10YR 5/2) silt coating on faces of peds; mixed with common very dark grayish brown (10YR 3/2) tubular material; slightly acid; clear wavy boundary.

Bt1—11 to 18 inches; yellowish brown (10YR 5/4) loam; moderate fine subangular blocky structure; friable; common faint dark brown (10YR 4/3) clay films on faces of peds; about 4 percent coarse fragments; neutral; abrupt wavy boundary.

Bt2—18 to 24 inches; yellowish brown (10YR 5/4) clay loam; moderately fine angular blocky structure; friable; common distinct dark brown (10YR 4/3 and 7YR 3/2) clay films on faces of peds and in root channels; about 6 percent coarse fragments concentrated in lower parts; neutral; abrupt wavy boundary.

2Bt3—24 to 30 inches; very dark grayish brown (10YR 3/2) clay; strong fine subangular blocky structure; very firm; about 4 percent coarse fragments; neutral; clear wavy boundary.

3C—30 to 60 inches; light gray (10YR 7/2) cobbly silt loam; massive; very friable; about 30 percent coarse fragments; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to carbonates range from 20 to 40 inches. Coarse fragments make up about 2 to 10 percent of the solum.

The 3C horizon contains 10 to 40 percent dominantly limestone coarse fragments ranging from pebbles to cobbles or channers that are in a fine earth consisting of silt loam, loam, or fine sandy loam. Hard limestone is at a depth of 50 inches or more.

The A horizon has chroma of 1 to 3. It is loam, silt loam, or fine sandy loam.

Some pedons have a 3- to 8-inch E horizon of sandy loam, loam, or silt loam that is dark grayish brown (10YR 4/2) or brown (10YR 5/3).

The Bt horizon has value of 4 or 5 and chroma of 3 or 4.

The 2Bt horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 2 to 4. It is sandy clay loam, clay loam, or clay. In many pedons, a stone line is common in the 2Bt horizon.

The 3C horizon has value of 6 or 7 and chroma of 1 to 6.

Terril Series

The Terril series consists of moderately well drained soils on till plains. Permeability is moderate in the solum and rapid in the substratum. The soils formed in local alluvium over sandy material. Slopes range from 1 to 3 percent.

The Terril soils in this survey area are more acid than the defined range for the series. This differences does not significantly affect use and management of the soils.

Typical pedon of Terril silt loam, in Frankford Township, 1,290 feet north and 1,150 feet west of the southeast corner of sec. 36, T. 103 N., R. 14 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; strongly acid; abrupt wavy boundary.

A—9 to 23 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; very dark brown (10YR 2/2) coatings on faces of peds; moderate very fine and fine granular structure; very friable; strongly acid; clear irregular boundary.

AB—23 to 30 inches; very dark grayish brown (10YR 3/2) loam; very dark brown (10YR 2/2) coatings on faces of peds; moderate very fine and fine granular structure; very friable; strongly acid; clear wavy boundary.

Bw—30 to 39 inches; dark brown (10YR 3/3) loam; very dark grayish brown (10YR 3/2) coatings on faces of peds; moderate fine and medium subangular blocky structure; very friable; strongly acid; clear wavy boundary.

BC—39 to 43 inches; dark brown to brown (10YR 4/3) sandy loam; weak medium subangular blocky structure; very friable; strongly acid; clear wavy boundary.

2C—43 to 60 inches; yellowish brown (10YR 5/6) coarse sand; single grained; loose; medium acid; abrupt wavy boundary.

The thickness of the solum ranges from 36 to 60 inches. The mollic epipedon is 24 to 39 inches thick.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is typically silt loam, but in some pedons it is loam.

The Bw horizon has value of 3 or 4 and chroma of 2 to 4. In some pedons it has few to common low-chroma mottles. It is loam to sandy loam.

The 2C horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 or 5, and chroma of 3 to 6. It is coarse sand or gravelly loamy coarse sand.

Tripoli Series

The Tripoli series consists of poorly drained, moderately permeable soils on till plains. These soils formed in silty and loamy sediments and in underlying firm loamy till. Slopes range from 0 to 2 percent.

Typical pedon of Tripoli silty clay loam, in Dexter Township, 1,300 feet north and 2,720 feet east of the southwest corner of sec. 8, T. 103 N., R. 16 W.

Ap—0 to 10 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; moderate medium granular structure; friable; neutral; abrupt smooth boundary.

A—10 to 16 inches; black (10YR 2/1) silty clay loam, black (10YR 2/1) dry; moderate medium granular structure; friable; neutral; gradual wavy boundary.

Bg1—16 to 23 inches; olive gray (5Y 4/2) silty clay loam; few fine prominent dark gray (10YR 4/1) mottles; moderate medium blocky structure; friable; neutral; gradual wavy boundary.

2Bg2—23 to 37 inches; olive gray (5Y 4/2) loam; few fine distinct dark grayish brown (2.5Y 4/2) mottles; moderate medium subangular blocky structure; firm; 3 percent gravel; neutral; gradual wavy boundary.

2Bg3—37 to 47 inches; olive brown (2.5Y 4/4) loam; few fine distinct olive gray (5Y 5/2) and few fine prominent yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; 3 percent gravel; neutral; gradual wavy boundary.

2C—47 to 60 inches; olive brown (2.5Y 4/4) loam; many medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; 3 percent gravel; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 36 to 48 inches. The mollic epipedon is 14 to 24 inches thick. The silty and loamy sediments are 22 to 28 inches thick. The volume of coarse fragments in the 2Bg and 2C horizons ranges from 2 to 8 percent.

The A horizon has value of 2 or 3. It is typically silty clay loam, but in some pedons it is clay loam.

The Bg horizon has hue of 2.5Y or 5Y, value of 3 to 5, and chroma of 1 to 4.

The 2Bg horizon has hue of 10YR to 5Y, value of 3 to 5, and chroma of 1 to 4. It is typically loam, but some pedons have a coarser textured or partially sorted subhorizon with as much as 20 percent coarse fragments in the upper part.

The 2C horizon has hue of 10YR or 2.5Y and value and chroma of 4 to 6. It is loam, sandy clay loam, or clay loam.

Udolpho Series

The Udolpho series consists of poorly drained soils on outwash plains and stream terraces. Permeability is moderate in the upper part and rapid in the lower part. The soils formed in loamy sediments over sandy and gravelly materials. Slopes range from 0 to 2 percent.

Typical pedon of Udolpho silt loam, in Lansing Township, 2,400 feet west and 100 feet north of the southeast corner of sec. 23, T. 103 N., R. 18 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, dark gray (10YR 4/1) dry; weak very fine granular structure; very friable; medium acid; abrupt wavy boundary.

E—8 to 13 inches; grayish brown (2.5Y 5/2) silt loam, light brownish gray (2.5Y 6/2) dry; few fine distinct brown to dark brown (10YR 4/3) mottles; moderate thin platy structure; very friable; medium acid; clear wavy boundary.

Btg1—13 to 21 inches; grayish brown (2.5Y 5/2) loam; common fine distinct olive brown (2.5Y 4/4) mottles; weak medium subangular blocky structure; friable; few distinct sand and silt coatings on faces of peds; common distinct clay films on faces of peds; strongly acid; clear wavy boundary.

Btg2—21 to 27 inches; grayish brown (2.5Y 5/2) loam; common medium distinct light olive brown (2.5Y 5/4) mottles; weak coarse subangular blocky structure; very friable; few sand and silt coatings on faces of peds; few distinct clay films on faces of peds; medium acid; clear wavy boundary.

2Cg1—27 to 40 inches; grayish brown (2.5Y 5/2) gravelly coarse sand; common medium prominent reddish brown (5YR 5/4) mottles; single grained; loose; 15 percent gravel; neutral; clear wavy boundary.

2Cg2—40 to 60 inches; grayish brown (2.5Y 5/2) gravelly coarse sand; common medium prominent reddish brown (5YR 5/4) mottles; single grained; loose; 20 percent gravel; slight effervescence; mildly alkaline.

The silty and loamy sediments are 20 to 40 inches thick. The depth to free carbonates is at least 36 inches. The solum typically does not have coarse fragments, but a few pedons contain as much as 10 percent gravel in the lower part of the solum.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. The A and E horizons are typically silt loam, but in some pedons they are loam.

The Btg horizon has hue of 2.5Y, 10YR, or 5Y, value of 4 or 5, and chroma of 1 or 2. The upper part typically is silt loam or loam, but in a few pedons it is silty clay loam or clay loam. The lower part typically is loam or sandy clay loam, but in some pedons it is clay loam.

The 2C horizon has hue of 2.5Y or 5Y. It mainly is gravelly coarse sand, sand, loamy coarse sand, or loamy sand. It contains 10 to 50 percent gravel. Some pedons have thin layers of finer textured materials.

Vlasaty Series

The Vlasaty series consists of moderately well drained, moderately slowly permeable soils on till plains. These soils formed in silty sediments and in underlying firm loamy till. Slopes range from 1 to 4 percent.

Typical pedon of Vlasaty silt loam, 1 to 4 percent slopes, in Le Roy Township, 450 feet west and 2,240 feet north of the southeast corner of sec. 33, T. 101 N., R. 14 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, dark brownish gray (10YR 4/2) dry; moderate very fine granular structure; very friable; medium acid; abrupt wavy boundary.

E—7 to 11 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; moderate thin platy structure; friable; medium acid; abrupt wavy boundary.

B/E—11 to 16 inches; brown (10YR 4/3) silty clay loam; few fine faint yellowish brown (10YR 5/4) mottles; moderate very fine and fine subangular blocky structure; firm (Bt); medium distinct grayish brown (10YR 5/2) sand and silt coatings on faces of peds (E); strongly acid; abrupt irregular boundary.

2Bt1—16 to 22 inches; brown (10YR 4/3) clay loam; few fine distinct grayish brown (2.5Y 4/2) mottles; moderate fine subangular blocky structure; firm; few distinct clay films on faces of peds; 3 percent gravel; strongly acid; clear wavy boundary.

2Bt2—22 to 28 inches; brown (10YR 4/3) clay loam; common medium distinct grayish brown (2.5Y 5/2) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; 3 percent gravel; few prominent light gray (10YR 7/1) sand and silt coatings on faces of peds; few distinct clay films on faces of peds; strongly acid; clear wavy boundary.

2Bt3—28 to 34 inches; yellowish brown (10YR 5/4) clay loam; many medium distinct grayish brown (2.5Y 5/2) and common medium prominent strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; 3 percent gravel; few prominent light gray (10YR 7/1) sand and silt coatings on faces of peds; few distinct clay films on faces of peds; strongly acid; clear wavy boundary.

2Bt4—34 to 50 inches; yellowish brown (10YR 5/4) clay loam; many coarse distinct grayish brown (2.5Y 5/2) and few medium prominent strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure; firm; few distinct clay films on faces of peds; 3 percent gravel; strongly acid; clear wavy boundary.

2C—50 to 60 inches; yellowish brown (10YR 5/6) loam; many coarse distinct grayish brown (2.5Y 5/2) and common coarse prominent strong brown (7.5YR 5/6) mottles; firm; few thin clay films on faces of peds; 3 percent gravel; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates typically range from 40 to 60 inches. The thickness of the silty sediment is 16 to 24 inches. The volume of coarse fragments in the 2Bt and 2C horizons ranges from 2 to 8 percent.

The A horizon has value of 3 to 5 and chroma of 1 or 2. The E horizon has value of 4 to 6. The 2Bt horizon has chroma of 3 to 6. It mainly is clay loam or loam. A sandy loam or coarser textured subhorizon as much as 5 inches thick is in the upper part of the 2Bt horizon in some pedons.

Waucoma Series

The Waucoma series consists of well drained soils on bedrock-controlled uplands. Permeability is moderate in the upper part of the solum and slow in the lower part. The soils formed in glacial drift and a thin layer of residuum over soft weathered limestone. Slopes range from 1 to 6 percent.

Typical pedon of Waucoma silt loam, 1 to 6 percent slopes, in Frankford Township, 2,000 feet east and 200 feet south of the northwest corner of sec. 9, T. 103 N., R. 14 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, gray (10YR 5/3) dry; weak very fine granular structure; very friable; slightly acid; clear wavy boundary.

E—7 to 14 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; weak very thin platy structure; very friable; medium acid; clear wavy boundary.

Bt1—14 to 18 inches; dark brown (10YR 4/3) silt loam; weak fine subangular blocky structure; friable; few distinct clay films on faces of peds; medium acid; abrupt wavy boundary.

Bt2—18 to 24 inches; dark brown (10YR 4/3) loam; moderate fine subangular blocky structure; friable; few distinct clay films on faces of peds; medium acid; abrupt wavy boundary.

Bt3—24 to 33 inches; brown (10YR 5/3) loam; weak medium subangular blocky structure; friable; few distinct clay films on faces of peds; medium acid; abrupt wavy boundary.

Bt4—33 to 40 inches; brown (10YR 5/3) silt loam; moderate medium subangular blocky structure; firm; few distinct clay films on faces of peds; medium acid; clear wavy boundary.

2Bt5—40 to 45 inches; brown (10YR 4/3) clay loam; weak medium prismatic structure; firm; few faint clay films on faces of peds; medium acid; abrupt wavy boundary.

3C—45 to 60 inches; yellowish brown (10YR 5/6) channery silt loam; massive; friable; 20 percent soft weathered limestone channers; strong effervescence; mildly alkaline.

The solum thickness ranges from 40 to 55 inches. There typically are no carbonates in the solum.

The A horizon has chroma of 1 or 2. The E horizon has value of 3 or 4 and chroma of 2 or 3. The texture of the A and E horizons is typically silt loam, but in some pedons it is loam. The Bt horizon has chroma of 3 or 4. It is loam, silt loam, or clay loam. The 2Bt horizon has value of 4 or 5 and chroma of 3 to 6. It is clay or clay loam. The 3C horizon has hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 4 to 8. It is the channery analogs of silt loam, loam, fine sandy loam, or sandy loam. It contains 15 to 35 percent soft weathered limestone pebbles or channers.

Waukee Series

The Waukee series consists of well drained soils on outwash plains and stream terraces. Permeability is moderate in the upper part and very rapid in the lower part. The soils formed in loamy sediment and sandy and gravelly underlying material. Slopes range from 0 to 6 percent.

Typical pedon of Waukee loam, 0 to 2 percent slopes, in Austin Township, 1,800 feet north and 1,200 feet east of the southwest corner of sec. 10, T. 102 N., R. 18 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; medium acid; clear wavy boundary.

A1—9 to 12 inches; very dark brown (10YR 2/2) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; medium acid; clear wavy boundary.

A2—12 to 16 inches; very dark brown (10YR 2/2) loam; weak fine subangular blocky structure; friable; medium acid; clear wavy boundary.

Bt—16 to 27 inches; dark brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; few distinct clay films on faces of peds; medium acid; clear wavy boundary.

2BC—27 to 32 inches; brown (10YR 4/3) loamy sand; single grained; loose; clay bridging a few sand grains; 10 percent gravel; medium acid; clear wavy boundary.

2C1—32 to 42 inches; brown (10YR 5/3) gravelly sand; single grained; loose; 15 percent gravel; medium acid; clear wavy boundary.

2C2—42 to 60 inches; yellowish brown (10YR 5/4) gravelly loamy coarse sand; single grained; loose; 15 percent gravel; medium acid.

The loamy sediment is 24 to 40 inches thick. The depth to free carbonates is greater than 60 inches. The thickness of the mollic epipedon ranges from 12 to 18 inches. The 2BC and 2C horizons are 5 to 35 percent gravel.

The A horizon has chroma of 1 or 2. It is typically loam, but in some pedons it is silt loam.

The Bt horizon has value of 3 to 5 and chroma of 3 to 6. It is loam or sandy clay loam.

The 2BC horizon has value of 4 or 5 and chroma of 3 to 6. It is gravelly loamy sand or loamy sand. It is stratified in some pedons. The 2C horizon has value of 5 or 6.

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Formation of the Soils

Soil is produced by soil-forming processes acting on parent materials. The characteristics of the soil at any one point are determined by (1) the nature of the parent material, (2) the climate, (3) the plant and animal life in and on the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have been in action.

Factors of Soil Formation

Climate and plant and animal life are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and minerals or glaciation and slowly change it into a soil that has genetically formed horizons. The effects of climate and plant and animal life are modified by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing of the parent material into a soil profile. Usually, a long time is required for the development of distinct soil horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four factors. Additionally, many of the processes of soil development require more study.

Parent Material

The surface of Mower County is covered by at least two distinct glaciations. The last glaciation occurred more than 13,000 years ago. The deposits are mostly glacial till and composed of material derived from reworked older glacial deposits.

The eastern two-thirds of the county is covered by the Iowan Erosion Surface and has a thin mantle of loess over dense till and erosional sediments. The Floyd, Kasson, Oran, Racine, Readlyn, Sargeant, Skyberg, and Tripoli soils formed in this material.

Glacial outwash deposits formed when the glaciers melted. These deposits are mainly on outwash plains and valley trains. Soils on these areas commonly have a sandy and gravelly substratum and a sandy to silty upper layer. Fairhaven, Hayfield, Lawler, Marshan, and Udolpho soils formed in glacial outwash deposits.

The western edge of the county is Cary-age drift covered by a thin mantle of loess. Blooming, Havana, Maxcreek, Moland, and Merton soils formed in this material. The glacial drift is calcareous and loamy.

Climate

Mower County has a cool, subhumid, continental-type climate that has wide variations in temperature from summer to winter. During winter, soil-forming processes are largely dormant. Generally, the soils are frozen to a depth of 2 to 3 feet for 4 or 5 months of the year. The depth to which frost penetrates depends on the quantity of snowfall late in fall or early in winter.

The climate is essentially uniform throughout the county. Differences in vegetation, soil material, and relief can cause variations in microclimate, however. Soils in prairie regions, for instance, are exposed to greater variations in temperature than those in forest regions. Because they contain more moisture and absorb heat more readily, Kasson and Tripoli soils warm up more slowly than moderately coarse textured Fairhaven and Hayfield soils. Soils on south- and west-facing slopes receive more sunlight than soils on north- and east-facing slopes; therefore, they tend to be drier and warmer. The interaction of all these factors affects the development of soils. For additional information about the climate of Mower County, see "Climate" at the beginning of this survey.

Plants and Animals

Two types of vegetation, forest and prairie, have strongly influenced soil formation in Mower County. This county is along the northern margin of an extensive zone of ecological tension between prairie and forest regions. Throughout the centuries this margin has advanced and retreated as shifts in climate patterns affected temperature, relative humidity, wind velocity, and precipitation patterns. Prairie fires also may have been a modifying factor in the formation of soils along the edge of the prairie. The activities of animals, except for earthworms, probably had little effect on soil formation.

Relief

The relief of Mower County is the product of the melting continental glacier that deposited drift and the later development of erosion and a drainage system. The relief ranges from nearly level on outwash plains and ground moraines to rolling in the northeast part of the county. The main drainage channels have developed since the retreat of the last glacier.

The topography is of two distinct types. One is a complex moraine of short, uneven slopes that have many small, indistinct drainage patterns along the western border. The other type is mature topography where slopes are long and uniform.

Time

Many of the soils in the county were first exposed to soil-forming processes 12,000 to 20,000 years ago. The Donnan and Stateline soils, however, formed in older glacial deposits, perhaps more than 100,000 years old, and recent alluvial deposits along the major rivers in the county have almost no development because they are so young.

In some instances the amount of development in a soil depends more on the intensity of soil weathering and the resistance of the soil material to weathering than on the age of the soil. For example, the Sargeant soils have been subject to more intense soil formation than have the other soils in the county. They have moderately distinct soil layers, or horizons. Other factors, besides time, also affect development. The effects of the water table in the Maxcreek soils have resulted in lower layers less pronounced than those in the the Moland soils, which have no water table.

Geology

The mainly nearly level to gently sloping plains that make up the county consist generally of a wide range of sediments. In a few places bedrock is near the surface, but Pleistocene sediments—mainly glacial till, outwash, alluvium, and loess—are in most places.

Devonian bedrock. The bedrock under nearly all of the county is of the Cedar Valley Formation, a formation of Devonian-age dolomitic limestone as much as 250 feet thick that was deposited beneath a midcontinental sea that covered much of southern Minnesota during the Paleozoic period *(3)*. The formation is underlain by Ordovician limestones and shales, some of which are near the surface in a few stream valleys in the northeastern part of the county.

The Cedar Valley Formation is close to the surface of areas near several rivers and streams. The Atkinson, Faxon Variant, Nordness Variant, Rossfield, and Waucoma soils contain material derived from the limestone of the formation. In most places the weathered limestone is covered by a few inches of clay that has been called residuum but which may be illuvial *(4)*.

Pleistocene sediments. The Pleistocene epoch covered the last 1 to 2 million years and at least four periods of glaciation in the Midwest: Nebraskan, Kansan, Illinoian, and Wisconsin. Periods of warm weather, known as the Afton, Yarmouth, and Sangamon interglacial periods, separated those glacial periods.

Kansan-age glacial till is thought to make up the subsoil and substratum of many of the soils in the county. It mostly is loamy, yellowish brown in well drained areas, and firm when moist. In this survey area it is in the Brownsdale, Kasson, Kenyon, Oran, Protivin, Readlyn, Riceville, Sargeant, Skyberg, Tripoli, and Vlasaty soils.

Soils formed during the Yarmouth and Sangamon periods and during Illinoian glaciation are called paleosols. Thick and strongly weathered, they make up the subsoil and substratum of the Donnan and Stateline soils and some of the Riceville soils.

Erosion during the Wisconsin glaciation of the paleosols and some of the underlying till produced stone lines and layers of sandy or loamy erosional sediments. The remnants of that process are known as pedisediments. They make up the lower layers of the Clyde, Floyd, Ostrander, Racine, and Schley soils (fig. 8).

Late in the Wisconsin period, a glacier known as the Des Moines lobe reached the western edge of the survey area at about the area of the Cedar River *(9, 5)*. Its melting formed a gently rolling moraine consisting mostly of glacial till that is brownish, loamy, and friable when moist. This till makes up the lower layers of the Blooming, Canisteo, Havana, Maxcreek, Merton, Moland, and Newry soils.

Meltwater from the Des Moines lobe flowed down what is now the Cedar River valley and formed a sandy outwash plain. The Iowan erosion surface formed sandy terraces along the streams and rivers in the eastern and central parts of the survey area. Several kinds of sandy material are on the uplands. Some of the low knolls

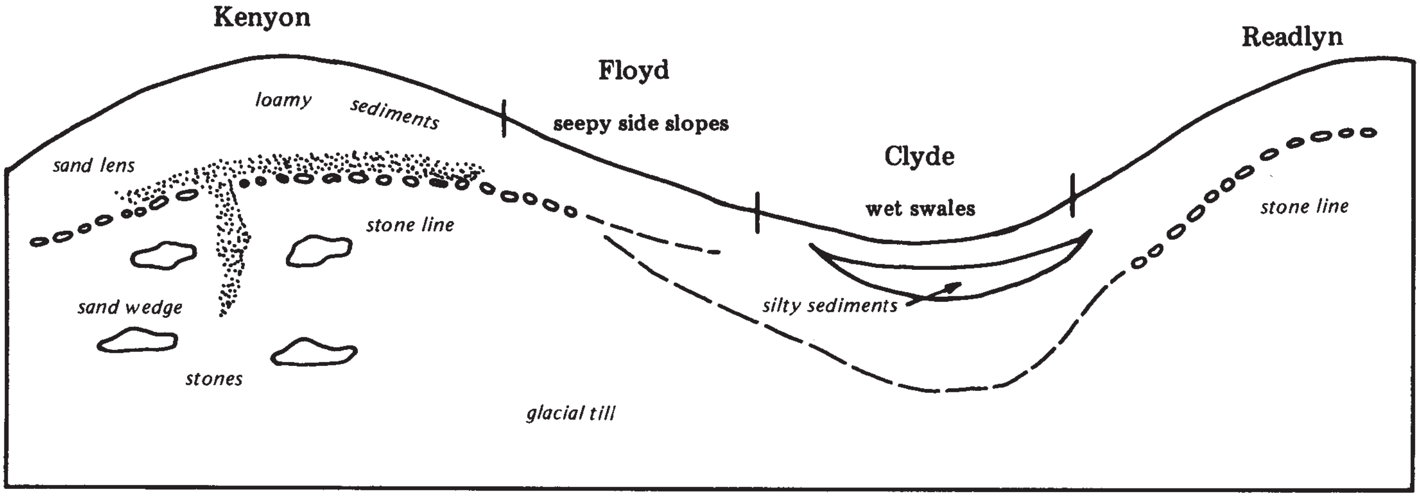
Kenyon
Floyd
Readlyn
loamy sediments
seepy side slopes
sand lens
Clyde
wet swales
stone line
stone line
sand wedge
silty sediments
stones
glacial till

Figure 8.—Parent materials of the Kenyon, Floyd, Clyde, and Readlyn soils.

appear to be stabilized dunes, and in places the sand that is mainly in the till is at the surface in the form of knolls. Another type of sand, Cretaceous sand, is near the surface in the eastern part of the survey area. The Billett, Cylinder, Dickinson, Dowagiac, Fairhaven, Hayfield, Lawler, Marshan, Mayer, Shandep, Terril, Udolpho, and Waukee soils have a subsoil or substratum consisting of one of the sandy materials.

Strong, persistent winds during the Wisconsin age blew silt off the outwash plains and deposited it on the uplands. These deposits, known as loess, cover nearly all of the survey area at a thickness ranging from 12 to 20 inches.

Recent sediments. The streams and rivers in the survey area continually deposit silty, loamy, or sandy alluvium on flood plains. The Kalmarville, Sawmill, and Spillville soils formed in those deposits. Plant debris has accumulated and decomposed in some wet areas, forming Palms soils, which are underlain by silty or loamy sediments.

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References

(1) American Association of State Highway and Transportation Officials. 1982. Standard specifications for highway materials and methods of sampling and testing. Ed. 13, 2 vols., illus.

(2) American Society for Testing and Materials. 1985. Standard test method for classification of soils for engineering purposes. ASTM Stand. D. 2487.

(3) Austin, G.S. 1972. Paleozoic lithostratigraphy of southeastern Minnesota. *In* Geology of Minnesota, a centennial volume. Pps. 454-473, illus.

(4) Frolking, T.A. 1982. The genesis and distribution of upland red clays in Wisconsin's driftless area. *In* Quarternary history of the driftless area. Field trip guidebook no. 5, 29th annual mtg., Midwest friends of the Pleistocene. Pps. 88-97.

(5) Ruhe, Robert V. 1969. Quaternary landscapes in Iowa. Iowa State Univ. Press, 255 pp., illus.

(6) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173-188 issued May 1962.]

(7) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conser. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

(8) University of Minnesota, Agricultural Experiment Station. 1955. Soils of Mower County, Minnesota. Misc. rep. 23. 28 pp., illus.

(9) Wright, H.E. 1972. Quaternary history of Minnesota. *In* Geology of Minnesota, a centennial volume. Pps. 515-547, illus.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	more than 9

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedding system. A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on the contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Broad-base terrace. A ridge-type terrace built to control erosion by diverting runoff along the contour at a nonscouring velocity. The terrace is 10 to 20 inches high and 15 to 30 feet wide and has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. It may be nearly level or have a grade toward one or both ends.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of a standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage and planting system in which crop residue covers at least 30 percent of the soil surface after planting. Where soil erosion by wind is the main concern, the system leaves the equivalent of at least 1,000 pounds per acre of flat small-grain residue on the surface during the critical erosion period.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Graded stripcropping. Growing crops in strips that grade toward a protected waterway.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Karst (topography). The relief of an area underlain by limestone that dissolves in differing degrees, thus forming numerous depressions or small basins.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Narrow-base terrace. A terrace no more than 4 to 8 feet wide at the base. A narrow-base terrace is similar to a broad-base terrace, except for the width of the ridge and channel.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called a "soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity and the pH values are expressed as—

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saprolite (soil science). Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Sloughed till. Water-saturated till that has flowed slowly downhill from its original place of deposit by glacial ice. It may rest on other till, on glacial outwash, or on a glaciolacustrine deposit.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons, Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-80 at Grand Meadow, Minnesota)

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	20.0	1.1	10.6	42	-27	0	0.95	0.29	1.48	3	13.1
February----	26.0	6.4	16.2	46	-21	0	.87	.25	1.37	3	9.4
March-------	36.1	18.1	27.1	64	-11	0	2.08	.93	3.05	5	11.8
April-------	53.7	34.0	43.9	84	13	35	2.77	1.60	3.81	7	2.9
May---------	67.5	45.7	56.6	88	27	242	4.14	2.62	5.51	8	.0
June--------	76.6	55.6	66.1	93	41	483	4.61	2.67	6.32	8	.0
July--------	81.0	59.8	70.4	95	46	632	4.10	1.80	6.05	7	.0
August------	78.8	57.0	67.9	92	42	555	4.07	1.39	6.27	7	.0
September---	70.2	47.9	59.1	89	30	278	3.27	1.17	5.01	6	.0
October-----	59.3	37.4	48.4	85	19	104	2.24	.72	3.48	4	.3
November----	41.5	23.6	32.6	68	-5	0	1.51	.36	2.42	4	4.4
December----	26.7	10.2	18.5	53	-20	0	.99	.38	1.49	3	9.8
Yearly:											
Average---	53.1	33.1	43.1	---	---	---	---	---	---	---	---
Extreme---	---	---	---	96	-28	---	---	---	---	---	---
Total-----	---	---	---	---	---	2,329	31.60	24.98	37.60	65	51.7

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-80 at Grand Meadow, Minnesota)

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 25	May 5	May 20
2 years in 10 later than--	Apr. 20	Apr. 30	May 15
5 years in 10 later than--	Apr. 10	Apr. 21	May 6
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 15	Sept. 29	Sept. 22
2 years in 10 earlier than--	Oct. 19	Oct. 4	Sept. 27
5 years in 10 earlier than--	Oct. 29	Oct. 13	Oct. 6

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-80 at Grand Meadow, Minnesota)

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	180	154	132
8 years in 10	187	161	139
5 years in 10	201	175	153
2 years in 10	214	188	166
1 year in 10	221	195	173

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
2A	Ostrander loam, 0 to 2 percent slopes	3,095	0.7
2B	Ostrander loam, 2 to 6 percent slopes	3,360	0.7
23	Skyberg silt loam	18,680	4.2
24B	Kasson silt loam, 1 to 4 percent slopes	5,990	1.3
27A	Dickinson fine sandy loam, 0 to 2 percent slopes	560	0.1
27B	Dickinson fine sandy loam, 2 to 6 percent slopes	410	0.1
30B	Kenyon silt loam, 1 to 6 percent slopes	3,340	0.7
44	Ankeny fine sandy loam	330	0.1
79B	Billett fine sandy loam, 2 to 6 percent slopes	2,690	0.6
83	Maxcreek silty clay loam, swales	570	0.1
88	Clyde silty clay loam	41,565	9.4
99A	Racine silt loam, 0 to 2 percent slopes	3,810	0.8
99B	Racine silt loam, 2 to 6 percent slopes	4,160	0.9
99C	Racine silt loam, 6 to 12 percent slopes	480	0.1
129	Cylinder loam	3,500	0.8
135	Donnan silt loam	2,300	0.5
156A	Fairhaven silt loam, 0 to 2 percent slopes	4,860	1.1
156B	Fairhaven silt loam, 2 to 6 percent slopes	540	0.1
190	Hayfield loam	4,290	1.0
228B	Mottland loam, 2 to 6 percent slopes	205	*
228C	Mottland loam, 6 to 12 percent slopes	835	0.2
244A	Lilah sandy loam, 0 to 2 percent slopes	695	0.2
244B	Lilah sandy loam, 2 to 6 percent slopes	1,150	0.3
244C	Lilah sandy loam, 6 to 12 percent slopes	610	0.1
252	Marshan clay loam	9,600	2.1
253	Maxcreek silty clay loam	4,700	1.0
255	Mayer loam	1,100	0.2
295	Readlyn silt loam	31,450	7.0
307	Sargeant silt loam	13,300	3.0
313	Spillville loam, occasionally flooded	2,420	0.5
331	Tripoli silty clay loam	75,770	16.8
334B	Vlasaty silt loam, 1 to 4 percent slopes	2,460	0.5
376B	Moland silt loam, 1 to 6 percent slopes	680	0.2
377	Merton silt loam	980	0.2
380	Havana silt loam	2,950	0.7
381	Newry silt loam	2,815	0.6
382B	Blooming silt loam, 2 to 6 percent slopes	4,770	1.1
382C	Blooming silt loam, 6 to 15 percent slopes	695	0.2
393	Udolpho silt loam	5,200	1.2
444	Canisteo silty clay loam	670	0.1
465	Kalmarville loam, frequently flooded	3,770	0.8
467	Sawmill silty clay loam	2,000	0.4
479	Floyd silt loam	18,400	4.1
483A	Waukee loam, 0 to 2 percent slopes	5,120	1.1
483B	Waukee loam, 2 to 6 percent slopes	1,690	0.4
485	Lawler silt loam	4,090	0.9
516A	Dowagiac loam, 0 to 2 percent slopes	6,615	1.5
516B	Dowagiac loam, 2 to 6 percent slopes	7,355	1.6
517	Shandep clay loam	2,930	0.7
539	Palms muck	1,500	0.3
631	Oran silt loam, 1 to 4 percent slopes	48,715	11.0
632	Kensett Variant silt loam	1,000	0.2
633B	Nordness Variant loam, 2 to 6 percent slopes	1,230	0.3
634	Protivin silt loam	780	0.2
635	Riceville silt loam	5,910	1.3
637	Schley silt loam	14,700	3.3
638B	Taopi silt loam, 1 to 6 percent slopes	3,110	0.7
638C	Taopi silt loam, 6 to 12 percent slopes	400	0.1
699A	Rossfield silt loam, 0 to 2 percent slopes	1,220	0.3
699B	Rossfield silt loam, 2 to 6 percent slopes	680	0.2
1013	Pits, quarry	265	0.1

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
1030	Udorthents-Pits complex	510	0.1
1078	Udorthents, nearly level to sloping	360	0.1
1812	Terril silt loam	1,010	0.2
1814B	Waucoma silt loam, 1 to 6 percent slopes	1,780	0.4
1841	Hayfield loam, loamy substratum	12,330	2.7
1844	Atkinson loam	860	0.2
1884	Stateline silt loam	4,670	1.0
1891	Faxon Variant silty clay loam	1,465	0.3
1903	Udolpho silt loam, loamy substratum, swales	3,300	0.7
1904	Udolpho silt loam, loamy substratum	11,460	2.5
1905	Brownsdale silt loam	7,450	1.7
1974	Coland-Spillville loams, frequently flooded	4,160	0.9
1992	Sargeant Variant silt loam	1,200	0.3
	Water	300	0.1
	Total	449,920	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
2A	Ostrander loam, 0 to 2 percent slopes
2B	Ostrander loam, 2 to 6 percent slopes
23	Skyberg silt loam (where drained)
24B	Kasson silt loam, 1 to 4 percent slopes
27A	Dickinson fine sandy loam, 0 to 2 percent slopes
27B	Dickinson fine sandy loam, 2 to 6 percent slopes
30B	Kenyon silt loam, 1 to 6 percent slopes
44	Ankeny fine sandy loam
88	Clyde silty clay loam (where drained)
99A	Racine silt loam, 0 to 2 percent slopes
99B	Racine silt loam, 2 to 6 percent slopes
129	Cylinder loam
135	Donnan silt loam
156A	Fairhaven silt loam, 0 to 2 percent slopes
156B	Fairhaven silt loam, 2 to 6 percent slopes
190	Hayfield loam
228B	Mottland loam, 2 to 6 percent slopes
252	Marshan clay loam (where drained)
253	Maxcreek silty clay loam (where drained)
255	Mayer loam (where drained)
295	Readlyn silt loam
307	Sargeant silt loam (where drained)
313	Spillville loam, occasionally flooded
331	Tripoli silty clay loam (where drained)
334B	Vlasaty silt loam, 1 to 4 percent slopes
376B	Moland silt loam, 1 to 6 percent slopes
377	Merton silt loam
380	Havana silt loam (where drained)
381	Newry silt loam
382B	Blooming silt loam, 2 to 6 percent slopes
393	Udolpho silt loam (where drained)
444	Canisteo silty clay loam (where drained)
467	Sawmill silty clay loam (where drained and either protected from flooding or not frequently flooded during the growing season)
479	Floyd silt loam
483A	Waukee loam, 0 to 2 percent slopes
483B	Waukee loam, 2 to 6 percent slopes
485	Lawler silt loam
516A	Dowagiac loam, 0 to 2 percent slopes
516B	Dowagiac loam, 2 to 6 percent slopes
517	Shandep clay loam (where drained)
631	Oran silt loam, 1 to 4 percent slopes
632	Kensett Variant silt loam
634	Protivin silt loam
635	Riceville silt loam (where drained)
637	Schley silt loam (where drained)
638B	Taopi silt loam, 1 to 6 percent slopes
699A	Rossfield silt loam, 0 to 2 percent slopes
699B	Rossfield silt loam, 2 to 6 percent slopes
1812	Terril silt loam
1814B	Waucoma silt loam, 1 to 6 percent slopes
1841	Hayfield loam, loamy substratum
1844	Atkinson loam
1884	Stateline silt loam (where drained)
1891	Faxon Variant silty clay loam (where drained)
1903	Udolpho silt loam, loamy substratum, swales (where drained)
1904	Udolpho silt loam, loamy substratum (where drained)
1905	Brownsdale silt loam (where drained)
1992	Sargeant Variant silt loam (where drained)

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Bromegrass-alfalfa	Kentucky bluegrass
		Bu	Bu	Bu	Tons	AUM*	AUM*
2A-------------- Ostrander	I	125	33	80	5.0	7.5	3.5
2B-------------- Ostrander	IIe	120	33	75	5.0	7.5	3.5
23-------------- Skyberg	IIIw	100	35	70	4.5	6.0	3.0
24B------------- Kasson	IIs	100	35	70	4.5	6.0	3.0
27A------------- Dickinson	IIs	83	32	62	3.0	5.0	2.7
27B------------- Dickinson	IIe	81	31	60	3.0	5.0	2.7
30B------------- Kenyon	IIe	120	43	90	4.7	7.8	4.2
44-------------- Ankeny	IIs	80	30	60	3.5	5.0	3.0
79B------------- Billett	IIIs	75	25	57	3.7	6.1	---
83-------------- Maxcreek	IIIw	110	35	70	---	---	3.5
88-------------- Clyde	IIw	102	39	82	4.0	6.6	6.6
99A------------- Racine	I	115	30	80	5.0	7.5	3.0
99B------------- Racine	IIe	110	30	80	5.0	7.5	3.0
99C------------- Racine	IIIe	95	25	75	5.0	7.5	3.0
129------------- Cylinder	IIs	88	33	70	3.7	6.1	3.3
135------------- Donnan	IIw	80	24	56	2.8	4.6	2.7
156A------------ Fairhaven	IIs	80	32	70	3.0	4.5	3.0
156B------------ Fairhaven	IIe	75	30	65	2.7	4.0	2.5
190------------- Hayfield	IIs	90	30	65	3.5	5.0	3.5

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Bromegrass-alfalfa	Kentucky bluegrass
		Bu	Bu	Bu	Tons	AUM*	AUM*
228B------------ Mottland	IIe	80	34	72	3.8	6.3	3.6
228C------------ Mottland	IVe	70	34	68	3.5	6.0	3.0
244A------------ Lilah	IVs	45	17	36	1.6	2.6	1.3
244B------------ Lilah	IVs	43	16	34	1.5	2.5	1.1
244C------------ Lilah	VIs	---	---	---	1.0	1.6	0.7
252------------- Marshan	IIw	100	35	70	4.0	6.0	3.5
253------------- Maxcreek	IIw	120	38	75	4.5	6.5	4.0
255------------- Mayer	IIw	80	32	60	3.0	5.0	3.2
295------------- Readlyn	I	120	43	90	4.7	7.8	4.1
307------------- Sargeant	IIIw	95	25	65	3.5	5.0	3.5
313------------- Spillville	IIw	156	48	94	6.2	8.6	4.2
331------------- Tripoli	IIw	115	42	89	4.5	7.5	4.1
334B------------ Vlasaty	IIe	90	27	67	5.0	6.5	3.0
376B------------ Moland	IIe	120	38	80	4.5	6.5	4.5
377------------- Merton	I	120	40	80	4.5	6.5	3.8
380------------- Havana	IIw	100	35	70	4.5	6.0	4.1
381------------- Newry	I	110	40	80	4.5	5.5	4.0
382B------------ Blooming	IIe	120	38	80	4.5	4.5	4.0
382C------------ Blooming	IIIe	100	33	75	4.0	4.5	4.0
393------------- Udolpho	IIw	100	30	70	3.5	5.0	4.0

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Bromegrass-alfalfa	Kentucky bluegrass
		Bu	Bu	Bu	Tons	AUM*	AUM*
444 Canisteo	IIw	110	36	75	3.5	5.2	3.0
465 Kalmarville	Vw	---	---	---	---	---	3.0
467:							
Sawmill drained	IIIw	120	36	76	5.5	---	4.0
Sawmill undrained	Vw	---	---	---	---	---	4.0
479 Floyd	IIw	120	40	85	4.5	7.5	4.1
483A Waukee	IIs	98	37	78	4.1	6.8	3.0
483B Waukee	IIe	96	36	77	4.0	6.6	2.0
485 Lawler	IIs	85	32	68	3.6	6.0	3.7
516A Dowagiac	IIIs	80	28	75	3.3	---	2.5
516B Dowagiac	IIIe	75	25	65	3.0	---	2.5
517:							
Shandep drained	IIIw	85	32	68	3.4	5.6	3.3
Shandep undrained	Vw	---	---	---	---	---	3.3
539:							
Palms drained	IIIw	105	42	65	---	---	---
Palms undrained	Vw	---	---	---	---	---	---
631 Oran	IIe	115	40	85	4.5	7.5	3.8
632 Kensett Variant	IIs	92	35	74	4.0	6.0	3.6
633B Nordness Variant	IVs	35	12	29	1.5	2.5	1.5
634 Protivin	IIw	100	33	70	3.7	6.1	3.6
635 Riceville	IIw	100	32	68	3.5	5.8	3.5
637 Schley	IIw	100	38	80	4.2	7.0	4.0

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Bromegrass-alfalfa	Kentucky bluegrass
		Bu	Bu	Bu	Tons	AUM*	AUM*
638B------------ Taopi	IIe	100	30	70	4.0	5.5	3.3
638C------------ Taopi	IIIe	90	26	60	3.8	5.4	2.5
699A------------ Rossfield	I	105	40	84	4.4	7.3	4.0
699B------------ Rossfield	IIe	103	39	82	4.3	7.1	3.8
1013**. Pits							
1030**. Udorthents-Pits							
1078. Udorthents							
1812------------ Terril	I	120	46	95	5.0	8.3	4.2
1814B----------- Waucoma	IIe	100	38	80	4.2	---	3.8
1841------------ Hayfield	IIs	90	30	65	3.5	5.0	4.0
1844------------ Atkinson	I	110	42	88	4.6	7.6	4.0
1884------------ Stateline	IIIw	75	25	60	3.0	4.5	3.5
1891------------ Faxon Variant	IIIw	85	30	65	3.0	3.5	---
1903------------ Udolpho	IIIw	90	25	65	3.0	3.5	4.0
1904------------ Udolpho	IIw	100	32	70	3.5	5.0	4.0
1905------------ Brownsdale	IIIw	100	30	70	3.5	5.0	3.0
1974------------ Coland-Spillville	Vw	---	---	---	---	---	3.3
1992------------ Sargeant Variant	IIIw	120	25	70	3.5	5.0	3.0

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
2A, 2B------------ Ostrander	---	Redosier dogwood, Siberian peashrub, gray dogwood, lilac.	Hackberry, Amur maple, blue spruce, eastern redcedar, northern white-cedar.	Eastern white pine, green ash.	---
23---------------- Skyberg	---	Northern white-cedar, lilac, Siberian peashrub.	White spruce, bur oak, hackberry, eastern redcedar.	Eastern white pine, green ash, Austrian pine.	---
24B--------------- Kasson	---	Redosier dogwood, lilac.	White spruce, northern white-cedar, blue spruce, Amur maple.	Green ash, eastern white pine, hackberry, Austrian pine.	Silver maple.
27A, 27B---------- Dickinson	Lilac-------------	Eastern redcedar, Siberian peashrub.	Eastern white pine, green ash, Norway spruce, honeylocust, red pine, Amur maple, hackberry.	---	---
30B--------------- Kenyon	---	Siberian peashrub, gray dogwood, redosier dogwood, lilac.	Northern white-cedar, hackberry, blue spruce, eastern redcedar, Amur maple.	Eastern white pine, green ash.	---
44---------------- Ankeny	---	Redosier dogwood, lilac.	Northern white-cedar, white spruce, blue spruce, Amur maple.	Hackberry, eastern white pine, Austrian pine, green ash.	Silver maple.
79B--------------- Billett	Lilac, manyflower cotoneaster.	Siberian peashrub, eastern redcedar.	Eastern white pine, red pine, Norway spruce, honeylocust, hackberry, green ash, Amur maple.	---	---
83---------------- Maxcreek	---	Redosier dogwood	Tall purple willow, black ash.	Black willow, white willow, golden willow.	---
88---------------- Clyde	---	Redosier dogwood, American plum.	Hackberry, Amur maple, northern white-cedar, tall purple willow, white spruce.	Golden willow, green ash.	Eastern cottonwood, silver maple.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
99A, 99B, 99C----- Racine	---	Gray dogwood, Siberian peashrub, redosier dogwood, lilac.	Eastern redcedar, northern white-cedar, blue spruce, hackberry, Amur maple.	Eastern white pine, green ash.	---
129--------------- Cylinder	---	Redosier dogwood, lilac.	Blue spruce, northern white-cedar, Amur maple, white spruce.	Austrian pine, eastern white pine, green ash, hackberry.	Silver maple.
135--------------- Donnan	---	Redosier dogwood, lilac.	Blue spruce, white spruce, northern white-cedar, Amur maple.	Green ash, Austrian pine, eastern white pine, hackberry.	Silver maple.
156A, 156B-------- Fairhaven	Lilac, Siberian peashrub.	Eastern redcedar, Manchurian crabapple, hackberry.	Bur oak, green ash, eastern white pine, honeylocust.	---	---
190--------------- Hayfield	---	Lilac, redosier dogwood.	Blue spruce, northern white-cedar, white spruce, Amur maple.	Eastern white pine, Austrian pine, hackberry, green ash.	Silver maple.
228B, 228C-------- Mottland	Russian-olive, Siberian peashrub, lilac.	Hackberry, eastern redcedar, Manchurian crabapple.	Eastern white pine, green ash, bur oak, honeylocust.	---	---
244A, 244B, 244C-- Lilah	Lilac, Siberian peashrub.	Eastern redcedar	Red pine, Austrian pine.	Eastern white pine	---
252--------------- Marshan	---	Redosier dogwood, American plum.	Hackberry, northern white-cedar, Amur maple, white spruce, tall purple willow.	Golden willow, green ash.	Silver maple, eastern cottonwood.
253--------------- Maxcreek	---	American plum, redosier dogwood.	Tall purple willow, hackberry, northern white-cedar, white spruce, Amur maple.	Golden willow, green ash.	Eastern cottonwood, silver maple.
255--------------- Mayer	---	Northern white-cedar, Siberian peashrub, lilac.	Hackberry, bur oak, white spruce, eastern redcedar.	Golden willow, green ash, honeylocust.	Eastern cottonwood.
295--------------- Readlyn	---	Redosier dogwood, lilac.	Northern white-cedar, white spruce, blue spruce, Amur maple.	Hackberry, eastern white pine, Austrian pine, green ash.	Silver maple.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
307 Sargeant	---	Eastern redcedar, northern white-cedar, lilac, Siberian peashrub.	Austrian pine, hackberry, white spruce, bur oak.	Eastern white pine, green ash.	---
313 Spillville	---	Redosier dogwood, lilac.	Northern white-cedar, white spruce, blue spruce, Amur maple.	Hackberry, eastern white pine, Austrian pine, green ash.	Silver maple.
331 Tripoli	---	Siberian peashrub, lilac, northern white-cedar.	Hackberry, bur oak, eastern redcedar, white spruce.	Golden willow, green ash, honeylocust.	Eastern cottonwood.
334B Vlasaty	---	Redosier dogwood, lilac.	White spruce, northern white-cedar, blue spruce, Amur maple.	Green ash, eastern white pine, hackberry, Austrian pine.	Silver maple.
376B Moland	---	Lilac, redosier dogwood, Siberian peashrub, gray dogwood.	Northern white-cedar, blue spruce, eastern redcedar, hackberry, Amur maple.	Eastern white pine, green ash.	---
377 Merton	---	Lilac, redosier dogwood.	Northern white-cedar, white spruce, blue spruce, Amur maple.	Eastern white pine, green ash, hackberry, Austrian pine.	Silver maple.
380 Havana	---	American plum, redosier dogwood.	White spruce, Amur maple, northern white-cedar, hackberry, tall purple willow.	Green ash, golden willow.	Eastern cottonwood, silver maple.
381 Newry	---	Redosier dogwood, lilac.	Northern white-cedar, white spruce, Amur maple, blue spruce.	Eastern white pine, green ash, hackberry, Austrian pine.	Silver maple.
382B, 382C Blooming	---	Lilac, Siberian peashrub, gray dogwood, redosier dogwood.	Eastern redcedar, blue spruce, northern white-cedar, Amur maple, hackberry.	Eastern white pine, green ash.	---
393 Udolpho	---	American plum, redosier dogwood.	Northern white-cedar, white spruce, tall purple willow, Amur maple, hackberry.	Green ash, golden willow.	Eastern cottonwood, silver maple.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
444 Canisteo	---	Siberian peashrub, lilac, northern white-cedar.	Hackberry, bur oak, white spruce, eastern redcedar.	Golden willow, honeylocust, green ash.	Eastern cottonwood.
465 Kalmarville	---	American plum, redosier dogwood.	Tall purple willow, hackberry, northern white-cedar, white spruce, Amur maple.	Golden willow, green ash.	Eastern cottonwood, silver maple.
467 Sawmill	---	American plum, redosier dogwood.	Northern white-cedar, white spruce, tall purple willow, hackberry, Amur maple.	Golden willow, green ash.	Eastern cottonwood, silver maple.
479 Floyd	---	Redosier dogwood, lilac.	Blue spruce, Amur maple, northern white-cedar, white spruce.	Austrian pine, hackberry, green ash, eastern white pine.	Silver maple.
483A, 483B Waukee	Lilac, Siberian peashrub.	Eastern redcedar, Manchurian crabapple, hackberry.	Green ash, bur oak, eastern white pine, honeylocust.	---	---
485 Lawler	---	Redosier dogwood, lilac.	Northern white-cedar, white spruce, blue spruce, Amur maple.	Eastern white pine, hackberry, Austrian pine, green ash.	Silver maple.
516A, 516B Dowagiac	---	Lilac, Amur privet, autumn-olive, silky dogwood.	Northern white-cedar, white spruce.	Red pine, eastern white pine, Norway spruce, Austrian pine.	---
517 Shandep drained	---	Redosier dogwood	Tall purple willow, black ash.	Black willow, white willow, golden willow.	---
539 Palms drained	Common ninebark	Whitebelle honeysuckle, Amur privet, silky dogwood.	Tall purple willow	Golden willow, black willow.	---
631 Oran	---	Redosier dogwood, lilac.	Northern white-cedar, white spruce, blue spruce, Amur maple.	Austrian pine, eastern white pine, green ash, hackberry.	Silver maple.
632 Kensett Variant	---	Redosier dogwood, lilac.	Blue spruce, northern white-cedar, white spruce, Amur maple.	Eastern white pine, Austrian pine, green ash, hackberry.	Silver maple.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
633B Nordness Variant	Lilac	Siberian peashrub, eastern redcedar.	Hackberry, Manchurian crabapple, eastern white pine, jack pine, green ash.	Siberian elm, honeylocust.	---
634 Protivin	Gray dogwood, silky dogwood.	Redosier dogwood, American plum.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, hackberry.	Eastern cottonwood, silver maple.
635 Riceville	---	Redosier dogwood, lilac.	Northern white-cedar, white spruce, blue spruce, Amur maple.	Austrian pine, eastern white pine, hackberry, green ash.	Silver maple.
637 Schley	---	Redosier dogwood, lilac.	Northern white-cedar, blue spruce, white spruce, Amur maple.	Green ash, Austrian pine, eastern white pine, hackberry.	Silver maple.
638B, 638C Taopi	Lilac	Eastern redcedar, Siberian peashrub, Manchurian crabapple.	Eastern white pine, honeylocust, green ash, hackberry, bur oak.	Siberian elm	---
699A, 699B Rossfield	---	Redosier dogwood, lilac, gray dogwood, Siberian peashrub.	Eastern redcedar, northern white-cedar, blue spruce, Amur maple, hackberry.	Eastern white pine, green ash.	---
1013*. Pits					
1030*: Udorthents.					
Pits.					
1078. Udorthents					
1812 Terril	---	Gray dogwood, Siberian peashrub, redosier dogwood, lilac.	Northern white-cedar, hackberry, blue spruce, eastern redcedar, Amur maple.	Eastern white pine, green ash.	---
1814B Waucoma	---	Redosier dogwood, lilac, gray dogwood, Siberian peashrub.	Amur maple, northern white-cedar, blue spruce, eastern redcedar, hackberry.	Eastern white pine, green ash.	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1841-------------- Hayfield	---	Lilac, Siberian crabapple, American plum.	Eastern redcedar, bur oak, northern white-cedar, hackberry, white spruce.	Green ash---------	Silver maple.
1844-------------- Atkinson	---	Redosier dogwood, gray dogwood, Siberian peashrub, lilac.	Northern white-cedar, eastern redcedar, blue spruce, Amur maple, hackberry.	Green ash, eastern white pine.	---
1884-------------- Stateline	---	American plum, redosier dogwood.	Hackberry, northern white-cedar, white spruce, tall purple willow, Amur maple.	Green ash, golden willow.	Silver maple, eastern cottonwood.
1891-------------- Faxon Variant	---	Redosier dogwood, American plum.	White spruce, northern white-cedar, tall purple willow, Amur maple, hackberry.	Golden willow, green ash.	Silver maple, eastern cottonwood.
1903-------------- Udolpho	---	Redosier dogwood	Black ash, tall purple willow.	Golden willow, black willow, white willow.	---
1904-------------- Udolpho	---	Northern white-cedar, medium purple willow, redosier dogwood.	Norway spruce, Amur maple, eastern white pine, Siberian crabapple.	Green ash, golden willow.	Eastern cottonwood, silver maple.
1905-------------- Brownsdale	---	American plum, redosier dogwood.	Hackberry, northern white-cedar, white spruce, tall purple willow, Amur maple.	Green ash, golden willow.	Silver maple, eastern cottonwood.
1974*: Coland-----------	---	Redosier dogwood, American plum.	White spruce, hackberry, northern white-cedar, tall purple willow, Amur maple.	Golden willow, green ash.	Eastern cottonwood, silver maple.
Spillville-------	---	Redosier dogwood, lilac.	Northern white-cedar, white spruce, blue spruce, Amur maple.	Hackberry, eastern white pine, Austrian pine, green ash.	Silver maple.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1992-------------- Sargeant Variant	---	American plum, redosier dogwood.	Hackberry, northern white-cedar, white spruce, tall purple willow, Amur maple.	Green ash, golden willow.	Silver maple, eastern cottonwood.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
2A Ostrander	Slight	Slight	Slight	Slight	Slight.
2B Ostrander	Slight	Slight	Moderate: slope.	Slight	Slight.
23 Skyberg	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
24B Kasson	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight	Slight.
27A Dickinson	Slight	Slight	Slight	Slight	Slight.
27B Dickinson	Slight	Slight	Moderate: slope.	Slight	Slight.
30B Kenyon	Slight	Slight	Moderate: slope.	Slight	Slight.
44 Ankeny	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
79B Billett	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
83 Maxcreek	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
88 Clyde	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
99A Racine	Slight	Slight	Slight	Slight	Slight.
99B Racine	Slight	Slight	Moderate: slope.	Slight	Slight.
99C Racine	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
129 Cylinder	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.
135 Donnan	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight	Slight.
156A Fairhaven	Slight	Slight	Slight	Slight	Slight.
156B Fairhaven	Slight	Slight	Moderate: slope.	Slight	Slight.
190 Hayfield	Slight	Slight	Moderate: slope.	Slight	Slight.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
228B Mottland	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: large stones.
228C Mottland	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: large stones, slope.
244A Lilah	Slight	Slight	Moderate: small stones.	Slight	Moderate: droughty.
244B Lilah	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: droughty.
244C Lilah	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
252 Marshan	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
253 Maxcreek	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
255 Mayer	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
295 Readlyn	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.
307 Sargeant	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
313 Spillville	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
331 Tripoli	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
334B Vlasaty	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
376B Moland	Slight	Slight	Moderate: slope.	Slight	Slight.
377 Merton	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.
380 Havana	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
381 Newry	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.
382B Blooming	Slight	Slight	Moderate: slope.	Slight	Slight.
382C Blooming	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
393 Udolpho	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
444 Canisteo	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
465 Kalmarville	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
467 Sawmill	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
479 Floyd	Severe: excess humus.	Severe: excess humus.	Severe: excess humus.	Severe: excess humus.	Slight.
483A Waukee	Slight	Slight	Slight	Slight	Slight.
483B Waukee	Slight	Slight	Moderate: slope.	Slight	Slight.
485 Lawler	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.
516A Dowagiac	Slight	Slight	Slight	Slight	Slight.
516B Dowagiac	Slight	Slight	Moderate: slope.	Slight	Slight.
517 Shandep	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
539 Palms	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
631 Oran	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
632 Kensett Variant	Severe: excess humus.	Severe: excess humus.	Severe: excess humus.	Severe: excess humus.	Slight.
633B Nordness Variant	Slight	Slight	Moderate: slope.	Slight	Moderate: large stones.
634 Protivin	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Slight	Slight.
635 Riceville	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Slight	Slight.
637 Schley	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
638B Taopi	Slight	Slight	Moderate: slope.	Slight	Slight.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
638C Taopi	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
699A Rossfield	Slight	Slight	Slight	Slight	Slight.
699B Rossfield	Slight	Slight	Moderate: slope.	Slight	Slight.
1013*. Pits					
1030*: Udorthents.					
Pits.					
1078. Udorthents					
1812 Terril	Slight	Slight	Slight	Slight	Slight.
1814B Waucoma	Slight	Slight	Moderate: slope.	Slight	Slight.
1841 Hayfield	Slight	Slight	Slight	Slight	Slight.
1844 Atkinson	Slight	Slight	Slight	Slight	Slight.
1884 Stateline	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
1891 Faxon Variant	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: large stones, wetness.
1903 Udolpho	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1904 Udolpho	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
1905 Brownsdale	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1974*: Coland	Severe: flooding, wetness.	Moderate: flooding, wetness.	Severe: wetness, flooding.	Moderate: wetness, flooding.	Severe: flooding.
Spillville	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
1992 Sargeant Variant	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
2A, 2B------------ Ostrander	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
23----------------- Skyberg	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair.
24B---------------- Kasson	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Fair	Very poor.
27A, 27B----------- Dickinson	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
30B---------------- Kenyon	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
44----------------- Ankeny	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
79B---------------- Billett	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
83----------------- Maxcreek	Good	Fair	Fair	Poor	Poor	Good	Good	Fair	Poor	Good.
88----------------- Clyde	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
99A, 99B----------- Racine	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
99C---------------- Racine	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
129---------------- Cylinder	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
135---------------- Donnan	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
156A, 156B--------- Fairhaven	Good	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.
190---------------- Hayfield	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
228B--------------- Mottland	Fair	Fair	Fair	Poor	Fair	Very poor.	Very poor.	Fair	Poor	Very poor.
228C--------------- Mottland	Poor	Fair	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Very poor.	Very poor.
244A, 244B--------- Lilah	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
244C--------------- Lilah	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
252---------------- Marshan	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
253---------------- Maxcreek	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
255---------------- Mayer	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
295---------------- Readlyn	Good	Good	Good	Fair	Fair	Fair	Fair	Good	Fair	Fair.
307---------------- Sargeant	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
313---------------- Spillville	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
331---------------- Tripoli	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
334B--------------- Vlasaty	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
376B--------------- Moland	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
377---------------- Merton	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
380---------------- Havana	Good	Good	Fair	Good	Fair	Good	Good	Good	Fair	Good.
381---------------- Newry	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
382B--------------- Blooming	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Poor.
382C--------------- Blooming	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Poor.
393---------------- Udolpho	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
444---------------- Canisteo	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
465---------------- Kalmarville	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
467---------------- Sawmill	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
479---------------- Floyd	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
483A, 483B--------- Waukee	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
485---------------- Lawler	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
516A, 516B Dowagiac	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
517 Shandep	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
539 Palms	Good	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
631 Oran	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
632 Kensett Variant	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
633B Nordness Variant	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
634 Protivin	Good	Fair	Good	Fair	Fair	Good	Good	Fair	Fair	Good.
635 Riceville	Good	Fair	Good	Fair	Fair	Good	Good	Fair	Fair	Good.
637 Schley	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
638B Taopi	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
638C Taopi	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
699A, 699B Rossfield	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
1013*. Pits										
1030*: Udorthents.										
Pits.										
1078. Udorthents										
1812 Terril	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
1814B Waucoma	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
1841 Hayfield	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
1844 Atkinson	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
1884--------------- Stateline	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
1891--------------- Faxon Variant	Fair	Fair	Fair	Poor	Poor	Good	Fair	Fair	Poor	Fair.
1903, 1904--------- Udolpho	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
1905--------------- Brownsdale	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
1974*:										
Coland------------	Poor	Fair	Fair	Poor	Poor	Good	Good	Poor	Poor	Good.
Spillville--------	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
1992--------------- Sargeant Variant	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
2A Ostrander	Slight	Slight	Slight	Slight	Moderate: frost action.	Slight.
2B Ostrander	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
23 Skyberg	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
24B Kasson	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action.	Slight.
27A Dickinson	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Slight.
27B Dickinson	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
30B Kenyon	Slight	Slight	Slight	Slight	Moderate: low strength, frost action.	Slight.
44 Ankeny	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
79B Billett	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Moderate: droughty.
83 Maxcreek	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
88 Clyde	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
99A Racine	Slight	Slight	Slight	Slight	Moderate: frost action.	Slight.
99B Racine	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
99C Racine	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
129 Cylinder	Severe: cutbanks cave, wetness.	Moderate: shrink-swell, wetness.	Severe: wetness.	Moderate: shrink-swell, wetness.	Severe: frost action.	Slight.
135 Donnan	Moderate: wetness, too clayey.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell, frost action.	Slight.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
156A Fairhaven	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Slight.
156B Fairhaven	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
190 Hayfield	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Severe: frost action.	Slight.
228B Mottland	Moderate: large stones.	Moderate: large stones.	Moderate: large stones.	Moderate: slope, large stones.	Moderate: large stones.	Moderate: large stones.
228C Mottland	Moderate: large stones, slope.	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: slope.	Moderate: slope, large stones.	Moderate: large stones, slope.
244A Lilah	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
244B Lilah	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
244C Lilah	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
252 Marshan	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
253 Maxcreek	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
255 Mayer	Severe: wetness, cutbanks cave.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
295 Readlyn	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
307 Sargeant	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
313 Spillville	Moderate: flooding, wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
331 Tripoli	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
334B Vlasaty	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Moderate: wetness.
376B Moland	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
377---------------- Merton	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
380---------------- Havana	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
381---------------- Newry	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action.	Slight.
382B--------------- Blooming	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.	Slight.
382C--------------- Blooming	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope.
393---------------- Udolpho	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
444---------------- Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
465---------------- Kalmarville	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.	Severe: wetness, flooding.
467---------------- Sawmill	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness, flooding.
479---------------- Floyd	Severe: cutbanks cave, excess humus, wetness.	Severe: low strength.	Severe: wetness.	Severe: low strength.	Severe: low strength, frost action.	Slight.
483A--------------- Waukee	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
483B--------------- Waukee	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Slight.
485---------------- Lawler	Severe: wetness, cutbanks cave.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
516A--------------- Dowagiac	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight---------	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.	Slight.
516B--------------- Dowagiac	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight---------	Moderate: shrink-swell, slope.	Moderate: low strength, shrink-swell.	Slight.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
517 Shandep	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
539 Palms	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.
631 Oran	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
632 Kensett Variant	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
633B Nordness Variant	Moderate: dense layer, large stones.	Moderate: large stones.	Moderate: large stones.	Moderate: slope, large stones.	Moderate: large stones.	Moderate: large stones.
634 Protivin	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
635 Riceville	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
637 Schley	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
638B Taopi	Moderate: too clayey.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.	Slight.
638C Taopi	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope.
699A Rossfield	Moderate: dense layer.	Slight	Slight	Slight	Severe: low strength.	Slight.
699B Rossfield	Moderate: dense layer.	Slight	Slight	Moderate: slope.	Severe: low strength.	Slight.
1013*. Pits						
1030*: Udorthents.						
Pits.						
1078. Udorthents						
1812 Terril	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: low strength, frost action.	Slight.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1814B Waucoma	Moderate: too clayey, dense layer.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, frost action, shrink-swell.	Slight.
1841 Hayfield	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Severe: frost action.	Slight.
1844 Atkinson	Moderate: too clayey, dense layer.	Slight	Slight	Slight	Moderate: low strength, frost action.	Slight.
1884 Stateline	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, frost action.	Severe: wetness.
1891 Faxon Variant	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: large stones, wetness.
1903 Udolpho	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
1904 Udolpho	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
1905 Brownsdale	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
1974*:						
Coland	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Severe: flooding.
Spillville	Moderate: flooding, wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding.
1992 Sargeant Variant	Severe: wetness.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
2A Ostrander	Slight	Moderate: seepage.	Slight	Slight	Fair: small stones.
2B Ostrander	Slight	Moderate: seepage, slope.	Slight	Slight	Fair: small stones.
23 Skyberg	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
24B Kasson	Severe: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Fair: wetness.
27A, 27B Dickinson	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
30B Kenyon	Moderate: percs slowly.	Moderate: slope, seepage.	Slight	Slight	Good.
44 Ankeny	Severe: flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Severe: flooding, seepage.	Fair: thin layer.
79B Billett	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy, small stones.
83 Maxcreek	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
88 Clyde	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
99A Racine	Slight	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey, small stones.
99B Racine	Slight	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey, small stones.
99C Racine	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, small stones, slope.
129 Cylinder	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, seepage.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
135 Donnan	Severe: percs slowly, wetness.	Slight	Severe: too clayey.	Moderate: wetness.	Poor: too clayey.
156A, 156B Fairhaven	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, small stones, too sandy.
190 Hayfield	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
228B Mottland	Moderate: large stones.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: large stones.
228C Mottland	Moderate: slope, large stones.	Severe: slope, seepage.	Severe: seepage.	Severe: seepage.	Poor: large stones.
244A, 244B Lilah	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
244C Lilah	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
252 Marshan	Severe: wetness, poor filter.	Severe: wetness, seepage.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
253 Maxcreek	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
255 Mayer	Severe: wetness, poor filter.	Severe: wetness, seepage.	Severe: wetness, seepage, too sandy.	Severe: wetness, seepage.	Poor: wetness, too sandy, seepage.
295 Readlyn	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
307 Sargeant	Severe: wetness, percs slowly.	Slight	Severe: wetness.	Severe: wetness.	Poor: wetness.
313 Spillville	Severe: wetness, flooding.	Severe: wetness, seepage, flooding.	Severe: wetness, seepage, flooding.	Severe: wetness, flooding.	Fair: wetness.
331 Tripoli	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
334B Vlasaty	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey, wetness.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
376B----------------- Moland	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
377------------------ Merton	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
380------------------ Havana	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
381------------------ Newry	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
382B----------------- Blooming	Slight-----------	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.
382C----------------- Blooming	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
393------------------ Udolpho	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
444------------------ Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
465------------------ Kalmarville	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness, seepage.	Poor: wetness.
467------------------ Sawmill	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
479------------------ Floyd	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Fair: too clayey, wetness.
483A, 483B----------- Waukee	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
485------------------ Lawler	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
516A, 516B----------- Dowagiac	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
517------------------ Shandep	Severe: ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Severe: ponding.	Poor: hard to pack, ponding.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
539 Palms	Severe: subsides, ponding.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, seepage.	Poor: ponding, excess humus.
631 Oran	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
632 Kensett Variant	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: large stones.
633B Nordness Variant	Moderate: large stones.	Severe: seepage.	Severe: seepage, large stones.	Severe: seepage.	Poor: large stones.
634 Protivin	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
635 Riceville	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
637 Schley	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
638B Taopi	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: large stones.
638C Taopi	Moderate: percs slowly, slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: large stones.
699A, 699B Rossfield	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: large stones.
1013*. Pits					
1030*: Udorthents.					
Pits.					
1078. Udorthents					
1812 Terril	Slight	Severe: seepage.	Severe: seepage.	Slight	Good.
1814B Waucoma	Severe: percs slowly.	Severe: seepage.	Severe: seepage.	Slight	Fair: thin layer.
1841 Hayfield	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1844---------------- Atkinson	Severe: percs slowly.	Severe: seepage.	Severe: seepage.	Slight-----------	Fair: too clayey, thin layer.
1884---------------- Stateline	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
1891---------------- Faxon Variant	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: wetness.
1903---------------- Udolpho	Severe: ponding, percs slowly, poor filter.	Severe: seepage, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding, thin layer.
1904---------------- Udolpho	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
1905---------------- Brownsdale	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
1974*:					
Coland-------------	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: wetness.
Spillville---------	Severe: wetness, flooding.	Severe: wetness, seepage, flooding.	Severe: wetness, seepage, flooding.	Severe: wetness, flooding.	Fair: wetness.
1992---------------- Sargeant Variant	Severe: wetness, percs slowly.	Moderate: seepage.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
2A, 2B Ostrander	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
23 Skyberg	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
24B Kasson	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
27A, 27B Dickinson	Good	Probable	Improbable: too sandy.	Good.
30B Kenyon	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
44 Ankeny	Good	Probable	Improbable: too sandy.	Good.
79B Billett	Good	Probable	Probable	Fair: small stones, area reclaim.
83 Maxcreek	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
88 Clyde	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
99A, 99B Racine	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
99C Racine	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
129 Cylinder	Fair: wetness.	Probable	Probable	Fair: area reclaim, small stones, thin layer.
135 Donnan	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
156A, 156B Fairhaven	Good	Probable	Probable	Poor: area reclaim, small stones.
190 Hayfield	Fair: wetness.	Probable	Improbable: too sandy.	Poor: area reclaim.
228B, 228C Mottland	Fair: large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
244A, 244B, 244C Lilah	Good	Probable	Probable	Poor: small stones, area reclaim.
252 Marshan	Fair: wetness.	Probable	Probable	Fair: area reclaim, thin layer.
253 Maxcreek	Fair: wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
255 Mayer	Fair: wetness.	Probable	Probable	Fair: area reclaim, thin layer.
295 Readlyn	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
307 Sargeant	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, wetness.
313 Spillville	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
331 Tripoli	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
334B Vlasaty	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
376B Moland	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
377 Merton	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
380 Havana	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
381 Newry	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
382B Blooming	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
382C Blooming	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
393 Udolpho	Fair: wetness.	Probable	Probable	Fair: area reclaim, thin layer.
444 Canisteo	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
465 Kalmarville	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
467 Sawmill	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
479 Floyd	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
483A, 483B Waukee	Good	Probable	Probable	Good.
485 Lawler	Fair: wetness.	Probable	Probable	Poor: area reclaim.
516A, 516B Dowagiac	Good	Probable	Probable	Poor: area reclaim, small stones.
517 Shandep	Poor: wetness.	Probable	Probable	Poor: wetness.
539 Palms	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess humus.
631 Oran	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
632 Kensett Variant	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, area reclaim.
633B Nordness Variant	Fair: large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, large stones.
634 Protivin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
635 Riceville	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
637 Schley	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
638B, 638C Taopi	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
699A, 699B Rossfield	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
1013*. Pits				
1030*: Udorthents.				

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1030*: Pits.				
1078. Udorthents				
1812 Terril	Good	Probable	Improbable: too sandy.	Good.
1814B Waucoma	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
1841 Hayfield	Fair: wetness.	Improbable: thin layer.	Improbable: too sandy.	Fair: small stones, area reclaim, thin layer.
1844 Atkinson	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
1884 Stateline	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, wetness.
1891 Faxon Variant	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
1903 Udolpho	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1904 Udolpho	Fair: wetness.	Probable	Probable	Fair: area reclaim, thin layer.
1905 Brownsdale	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1974*: Coland	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Spillville	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
1992 Sargeant Variant	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey, thin layer.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
2A Ostrander	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Favorable	Favorable.
2B Ostrander	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Favorable	Favorable.
23 Skyberg	Moderate: seepage.	Moderate: piping, wetness.	Frost action	Wetness, rooting depth, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily, rooting depth.
24B Kasson	Slight	Severe: piping.	Frost action	Wetness, rooting depth.	Wetness	Rooting depth.
27A Dickinson	Severe: seepage.	Severe: seepage.	Deep to water	Soil blowing	Soil blowing, too sandy.	Favorable.
27B Dickinson	Severe: seepage.	Severe: seepage.	Deep to water	Soil blowing, slope.	Soil blowing, too sandy.	Favorable.
30B Kenyon	Moderate: slope, seepage.	Moderate: piping.	Deep to water	Slope	Favorable	Favorable.
44 Ankeny	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, flooding.	Soil blowing	Favorable.
79B Billett	Severe: seepage.	Severe: piping.	Deep to water	Slope, droughty, soil blowing.	Too sandy, soil blowing.	Droughty, rooting depth.
83 Maxcreek	Moderate: seepage.	Severe: piping, ponding.	Ponding, frost action.	Ponding	Ponding	Wetness.
88 Clyde	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness	Wetness, erodes easily.
99A Racine	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Favorable	Favorable.
99B Racine	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Favorable	Favorable.
99C Racine	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope	Slope.
129 Cylinder	Severe: seepage.	Severe: seepage, piping.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Favorable.
135 Donnan	Slight	Severe: hard to pack.	Percs slowly, frost action.	Percs slowly, wetness.	Wetness, percs slowly.	Percs slowly.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
156A Fairhaven	Severe: seepage.	Severe: seepage, piping.	Deep to water	Favorable	Erodes easily, too sandy.	Erodes easily.
156B Fairhaven	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope	Erodes easily, too sandy.	Erodes easily.
190 Hayfield	Severe: seepage.	Severe: seepage, piping.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Favorable.
228B Mottland	Severe: seepage.	Moderate: seepage, piping, large stones.	Deep to water	Rooting depth, slope, large stones.	Large stones	Rooting depth, large stones.
228C Mottland	Severe: seepage, slope.	Moderate: seepage, piping, large stones.	Deep to water	Rooting depth, slope, large stones.	Slope, large stones.	Slope, rooting depth, large stones.
244A Lilah	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
244B Lilah	Severe: seepage.	Severe: seepage.	Deep to water	Slope, droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
244C Lilah	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
252 Marshan	Severe: seepage.	Severe: seepage, piping, wetness.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Wetness.
253 Maxcreek	Moderate: seepage.	Severe: piping, wetness.	Frost action	Wetness	Wetness	Wetness.
255 Mayer	Severe: seepage.	Severe: seepage, wetness.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Wetness.
295 Readlyn	Moderate: seepage.	Moderate: wetness, piping.	Frost action	Wetness	Wetness	Favorable.
307 Sargeant	Slight	Severe: wetness.	Percs slowly, frost action.	Wetness, percs slowly, rooting depth.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, rooting depth.
313 Spillville	Moderate: seepage.	Moderate: piping, wetness.	Deep to water	Flooding	Favorable	Favorable.
331 Tripoli	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness	Wetness.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
334B Vlasaty	Slight	Moderate: thin layer, piping, wetness.	Frost action	Wetness, rooting depth.	Erodes easily, wetness.	Erodes easily, rooting depth.
376B Moland	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Favorable	Favorable.
377 Merton	Moderate: seepage.	Severe: piping.	Frost action	Wetness	Wetness	Favorable.
380 Havana	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness	Wetness.
381 Newry	Moderate: seepage.	Severe: piping.	Frost action	Wetness	Wetness	Favorable.
382B Blooming	Moderate: slope, seepage.	Moderate: piping.	Deep to water	Slope	Favorable	Favorable.
382C Blooming	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope	Slope.
393 Udolpho	Severe: seepage.	Severe: seepage, wetness.	Frost action, cutbanks cave.	Wetness	Erodes easily, wetness, too sandy.	Wetness, erodes easily.
444 Canisteo	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness	Wetness.
465 Kalmarville	Severe: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, flooding.	Wetness	Wetness.
467 Sawmill	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Wetness, flooding.	Wetness	Wetness.
479 Floyd	Severe: seepage.	Moderate: piping, wetness.	Frost action	Wetness	Wetness	Favorable.
483A Waukee	Severe: seepage.	Severe: seepage.	Deep to water	Favorable	Too sandy	Favorable.
483B Waukee	Severe: seepage.	Severe: seepage.	Deep to water	Slope	Too sandy	Favorable.
485 Lawler	Severe: seepage.	Severe: seepage.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Favorable.
516A Dowagiac	Severe: seepage.	Severe: seepage.	Deep to water	Favorable	Too sandy	Favorable.
516B Dowagiac	Severe: seepage.	Severe: seepage.	Deep to water	Slope	Too sandy	Favorable.
517 Shandep	Moderate: seepage.	Severe: ponding.	Ponding, frost action.	Ponding	Ponding	Wetness.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
539 Palms	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
631 Oran	Moderate: seepage.	Moderate: piping, wetness.	Frost action	Wetness	Wetness	Favorable.
632 Kensett Variant	Severe: seepage.	Severe: piping.	Large stones, frost action.	Wetness, rooting depth.	Large stones, wetness.	Large stones, rooting depth.
633B Nordness Variant	Severe: seepage.	Severe: piping, large stones.	Deep to water	Large stones, rooting depth, slope.	Large stones, erodes easily.	Large stones, erodes easily.
634 Protivin	Slight	Moderate: wetness.	Frost action	Wetness, rooting depth.	Erodes easily, wetness.	Erodes easily, rooting depth.
635 Riceville	Slight	Moderate: wetness.	Frost action	Wetness	Wetness	Favorable.
637 Schley	Moderate: seepage.	Severe: wetness.	Frost action	Wetness, rooting depth.	Wetness	Wetness, rooting depth.
638B Taopi	Severe: seepage.	Severe: piping.	Deep to water	Slope, rooting depth.	Favorable	Rooting depth.
638C Taopi	Severe: seepage, slope.	Severe: piping.	Deep to water	Slope, rooting depth.	Slope	Slope, rooting depth.
699A Rossfield	Severe: seepage.	Moderate: piping.	Deep to water	Rooting depth	Favorable	Rooting depth.
699B Rossfield	Severe: seepage.	Moderate: piping.	Deep to water	Slope, rooting depth.	Favorable	Rooting depth.
1013*. Pits						
1030*: Udorthents.						
Pits.						
1078. Udorthents						
1812 Terril	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Favorable	Favorable	Favorable.
1814B Waucoma	Moderate: seepage, slope.	Severe: piping.	Deep to water	Percs slowly, slope.	Large stones	Favorable.
1841 Hayfield	Severe: seepage.	Severe: seepage, piping.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Favorable.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1844 Atkinson	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Percs slowly, rooting depth.	Large stones	Rooting depth.
1884 Stateline	Slight	Severe: wetness.	Percs slowly, frost action.	Wetness, percs slowly, rooting depth.	Wetness, percs slowly.	Wetness, rooting depth, percs slowly.
1891 Faxon Variant	Severe: seepage.	Severe: wetness.	Frost action	Wetness, rooting depth.	Large stones, wetness.	Wetness, rooting depth.
1903 Udolpho	Severe: seepage.	Severe: ponding.	Ponding, frost action.	Ponding	Erodes easily, ponding.	Wetness, erodes easily.
1904 Udolpho	Severe: seepage.	Severe: seepage, wetness.	Frost action, cutbanks cave.	Wetness	Erodes easily, wetness, too sandy.	Wetness, erodes easily.
1905 Brownsdale	Moderate: seepage.	Severe: piping, wetness.	Frost action	Wetness	Wetness	Wetness.
1974*:						
Coland	Severe: seepage.	Severe: wetness.	Flooding, frost action.	Wetness, flooding.	Wetness	Wetness.
Spillville	Moderate: seepage.	Moderate: piping, wetness.	Deep to water	Flooding	Favorable	Favorable.
1992 Sargeant Variant	Moderate: seepage.	Moderate: hard to pack, wetness.	Percs slowly, frost action.	Wetness, percs slowly, rooting depth.	Wetness, percs slowly.	Wetness, rooting depth, percs slowly.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
2A, 2B Ostrander	0-16	Loam	CL-ML, CL	A-4, A-6	0	100	98-100	90-95	70-90	25-40	5-15
	16-20	Loam, silt loam	CL, CL-ML	A-4, A-6	0-1	95-100	95-100	90-95	70-90	25-40	5-15
	20-50	Loam, sandy clay loam.	CL, SC	A-6	2-5	95-100	75-100	65-90	45-65	25-35	10-15
	50-60	Loam	CL	A-6	1-5	95-100	90-100	80-95	50-75	25-40	10-20
23 Skyberg	0-12	Silt loam	CL	A-6, A-4	0	100	95-100	90-100	70-90	25-40	8-15
	12-21	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	95-100	90-100	70-95	35-50	15-25
	21-50	Loam	CL	A-6, A-4	0-5	90-100	85-95	70-90	50-70	25-40	8-19
	50-60	Loam	CL	A-6, A-4	0-5	90-100	85-95	70-90	50-70	25-40	8-19
24B Kasson	0-11	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	95-100	75-95	25-40	4-15
	11-16	Silty clay loam, silt loam, loam.	CL	A-6, A-7	0	100	95-100	90-100	75-95	35-45	15-25
	16-60	Loam, sandy clay loam.	CL, ML	A-6, A-4	0-5	95-100	85-95	70-90	50-80	25-40	8-18
27A, 27B Dickinson	0-16	Fine sandy loam	SM, SC, SM-SC	A-4, A-2	0	100	100	85-95	30-50	15-30	NP-10
	16-30	Fine sandy loam, sandy loam.	SM, SC, SM-SC	A-4	0	100	100	85-95	35-50	15-30	NP-10
	30-40	Loamy sand, loamy fine sand.	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	80-95	5-20	10-20	NP-5
	40-60	Sand, loamy fine sand, loamy sand.	SM, SP-SM	A-3, A-2	0	100	100	70-90	5-20	---	NP
30B Kenyon	0-24	Silt loam	CL	A-6	0	100	95-100	85-95	65-75	30-40	10-20
	24-48	Loam, clay loam, silt loam.	CL	A-6	0-5	90-95	85-95	80-90	50-65	30-40	10-20
	48-60	Loam	CL	A-6	0-5	90-95	85-95	80-90	50-65	25-35	10-20
44 Ankeny	0-30	Fine sandy loam	SM, SC, SM-SC	A-4, A-2	0-5	95-100	95-100	75-90	30-50	<25	2-10
	30-54	Fine sandy loam, sandy loam.	SM, SC, SM-SC	A-4, A-2	0-5	95-100	95-100	75-90	25-45	<25	2-10
	54-60	Loamy fine sand, fine sandy loam, fine sand.	SM, SC, SM-SC, SW-SM	A-4, A-2, A-3	0-5	95-100	95-100	70-80	5-40	<25	NP-10
79B Billett	0-7	Fine sandy loam	SM, SM-SC, SC	A-2, A-4	0	100	100	85-100	25-50	<25	2-10
	7-24	Sandy loam, fine sandy loam.	SM-SC, SC	A-2, A-4, A-6	0-10	90-100	90-100	85-100	25-50	20-30	5-15
	24-36	Loamy fine sand, sandy loam, fine sandy loam.	SM, SM-SC, SC	A-2, A-4, A-6	0-10	75-100	75-100	75-90	20-45	15-30	3-15
	36-60	Loamy sand, sand, loamy fine sand.	SM, SM-SC, SW-SM, SP-SM	A-2, A-1-b, A-3	0-10	60-100	60-100	20-75	5-30	<25	NP-5

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
83--------------- Maxcreek	0-22	Silty clay loam	CL, MH, ML, CH	A-7	0	100	100	95-100	92-100	40-55	15-25
	22-30	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	95-100	85-95	75-90	35-50	15-25
	30-39	Loam, clay loam	CL, ML, CL-ML	A-4, A-6	0-5	95-100	90-95	60-80	50-75	25-40	5-20
	39-60	Loam, sandy clay loam.	CL, ML, CL-ML	A-4, A-6	0-5	95-100	90-95	60-80	50-75	25-40	5-20
88--------------- Clyde	0-22	Silty clay loam	OL, MH, ML, OH	A-7	0-5	95-100	95-100	80-90	55-75	45-60	15-25
	22-27	Loam, silty clay loam.	CL, ML	A-6, A-7	0-5	95-100	90-95	75-90	50-75	30-50	10-20
	27-50	Sandy loam, loam, sandy clay loam.	SM, SM-SC	A-2	2-5	80-95	75-90	50-80	15-35	15-20	NP-5
	50-60	Loam, sandy clay loam, sandy loam.	CL, SC	A-6	2-5	90-95	85-90	75-90	45-65	25-35	10-20
99A, 99B, 99C---- Racine	0-13	Silt loam--------	ML	A-4, A-6	0	95-100	95-100	90-100	55-85	30-40	5-14
	13-20	Silt loam, clay loam, silty clay loam.	CL	A-6	0	95-100	95-100	90-100	55-85	30-40	10-20
	20-45	Clay loam, sandy clay loam, loam.	CL, SC	A-6	2-5	95-100	75-100	65-90	45-65	25-35	10-15
	45-60	Loam-------------	ML, CL	A-6	1-5	95-100	90-100	80-95	50-75	25-40	10-20
129-------------- Cylinder	0-16	Loam-------------	CL	A-6, A-7	0	100	90-100	80-100	50-75	30-50	10-25
	16-31	Loam, clay loam, sandy loam.	CL, SC	A-6	0	95-100	80-100	80-95	45-70	30-40	10-20
	31-60	Gravelly sand, loamy sand, loamy coarse sand.	SP-SM, SM	A-1, A-2, A-3	0-10	65-95	65-95	20-55	5-25	---	NP
135-------------- Donnan	0-18	Silt loam, loam	CL, ML	A-4, A-6	0	100	100	85-95	65-80	30-40	5-15
	18-29	Clay loam, silty clay loam, loam.	CL	A-6	0-5	95-100	90-95	80-90	60-75	30-40	10-20
	29-60	Clay, silty clay	CH	A-7	0-5	95-100	90-95	80-90	60-75	55-70	30-40
156A, 156B------- Fairhaven	0-15	Silt loam--------	ML, CL	A-4, A-6	0	95-100	95-100	80-95	60-85	25-40	NP-15
	15-30	Silt loam, loam	ML, CL	A-4, A-6	0	95-100	95-100	80-95	60-85	25-40	2-15
	30-60	Stratified gravelly coarse sand to loamy sand.	SP, SP-SM, GP, GP-GM	A-1	0-5	50-100	35-100	20-50	1-10	---	NP
190-------------- Hayfield	0-13	Loam-------------	CL-ML, CL	A-6, A-4	0	100	100	90-98	70-90	25-40	6-15
	13-29	Loam, silt loam, sandy clay loam.	CL-ML, CL	A-4, A-6	0	95-100	90-100	70-90	65-80	25-40	6-15
	29-60	Coarse sand, gravelly coarse sand, sand.	SP, SP-SM	A-1	0-3	85-100	50-98	25-50	0-15	---	NP
228B, 228C------- Mottland	0-7	Loam-------------	CL, CL-ML	A-6, A-4	3-10	90-95	75-85	70-80	55-65	25-40	5-15
	7-60	Channery fine sandy loam, channery sandy loam, channery loam.	SM, SC, SM-SC	A-2	15-35	80-90	75-85	50-60	20-30	<20	2-8

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
244A, 244B, 244C-	0-8	Sandy loam-------	SM-SC, SC	A-2, A-4	0-5	90-95	80-90	60-70	25-40	<25	5-10
Lilah	8-16	Sandy loam, gravelly sandy loam.	SM, SM-SC, SC	A-2-4, A-1-b	0-5	80-95	60-90	40-60	15-30	<25	3-10
	16-36	Gravelly loamy sand, sand, loamy sand.	SW, SW-SM, SP, SP-SM	A-1-b	0-10	70-90	50-90	30-50	3-12	---	NP
	36-60	Loamy sand, gravelly coarse sand, sand.	GP, SP, GP-GM, SP-SM	A-1-b	0-10	50-100	40-100	30-50	3-12	---	NP
252--------------	0-14	Clay loam--------	CL	A-7, A-6	0	95-100	95-100	95-100	80-95	35-50	15-25
Marshan	14-26	Silty clay loam, clay loam, silt loam.	CL	A-7, A-6	0	95-100	95-100	95-100	80-95	30-50	15-30
	26-29	Loam, sandy loam, silt loam.	CL, CL-ML, SC, SM-SC	A-6, A-4	0	95-100	75-100	70-90	45-75	25-40	5-15
	29-60	Coarse sand, gravelly coarse sand, coarse sand.	SP, SW, SP-SM	A-1	0-3	65-95	45-95	20-45	2-5	---	NP
253--------------	0-18	Silty clay loam	CL, MH, ML, CH	A-7	0	100	100	95-100	92-100	40-55	15-25
Maxcreek	18-28	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	95-100	85-95	75-90	35-50	15-25
	28-35	Loam, clay loam	CL, ML, CL-ML	A-4, A-6	0-5	95-100	90-95	60-80	50-75	25-40	5-20
	35-60	Loam, sandy clay loam.	CL, ML, CL-ML	A-4, A-6	0-5	95-100	90-95	60-80	50-75	25-40	5-20
255--------------	0-20	Loam-------------	CL, ML	A-6, A-4	0-2	95-100	85-100	70-90	50-85	30-40	5-15
Mayer	20-36	Loam, sandy clay loam, sandy loam.	CL, SC, ML, SM	A-6, A-4	0-5	90-100	85-100	70-90	40-85	30-40	5-15
	36-60	Gravelly coarse sand, gravelly sand, coarse sand.	SP, SW, SP-SM	A-1	0-10	65-95	45-85	20-45	2-10	<20	NP
295--------------	0-22	Silt loam--------	CL	A-6	0	100	100	85-95	55-75	30-40	15-25
Readlyn	22-47	Loam, clay loam, sandy loam.	CL, SC	A-6	2-5	90-95	85-90	75-85	45-65	30-40	10-20
	47-60	Loam, sandy clay loam.	CL, SC	A-6	2-5	90-95	85-90	75-85	45-65	25-35	10-20
307--------------	0-12	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	90-100	75-90	25-40	5-15
Sargeant	12-22	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	95-100	90-100	75-95	30-45	10-25
	22-45	Clay loam, loam, sandy loam.	CL	A-6, A-7	0-5	95-100	90-100	75-90	50-80	30-45	10-20
	45-60	Loam, sandy clay loam.	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	75-90	50-70	25-40	5-15
313--------------	0-52	Loam-------------	CL	A-6	0	100	95-100	85-95	60-80	25-40	10-20
Spillville	52-60	Sandy clay loam, loam, sandy loam.	CL, CL-ML, SM-SC, SC	A-6, A-4	0	100	95-100	80-90	35-75	20-40	5-15
331--------------	0-23	Silty clay loam	CL	A-6, A-7	0	100	100	85-95	55-75	35-45	15-25
Tripoli	23-47	Loam-------------	CL	A-6	2-5	90-95	85-90	75-85	55-65	30-40	11-20
	47-60	Loam, sandy clay loam, clay loam.	CL, SC	A-6	2-5	90-95	85-90	75-85	45-65	30-40	11-20

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
334B-------------	0-11	Silt loam--------	CL, ML	A-4, A-6	0	100	100	95-100	80-95	30-40	5-15
Vlasaty	11-16	Silt loam, silty clay loam.	CL	A-4, A-6	0	100	100	95-100	80-95	25-40	8-15
	16-50	Clay loam, loam	CL	A-6, A-7	0-2	95-100	90-100	75-90	50-80	30-45	10-20
	50-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-2	95-100	90-100	75-90	50-80	25-40	5-15
376B-------------	0-14	Silt loam--------	ML, CL	A-6, A-4	0	100	100	85-100	50-85	30-40	5-15
Moland	14-19	Silt loam, loam	ML, CL	A-6, A-4, A-7	0	100	100	85-100	50-85	30-45	5-20
	19-45	Loam, clay loam	CL, ML, CL-ML	A-6, A-4	0-5	95-100	90-98	60-75	50-65	25-40	5-15
	45-60	Loam, sandy loam	CL, ML, CL-ML	A-6, A-4	0-5	95-100	90-98	60-80	50-75	25-40	5-15
377--------------	0-16	Silt loam--------	CL-ML, CL	A-6, A-4	0	100	100	85-100	75-90	25-40	5-15
Merton	16-23	Silt loam, loam	CL, CL-ML	A-6, A-4	0	100	100	85-100	65-80	25-40	5-15
	23-60	Loam, clay loam, sandy loam.	CL, ML, CL-ML	A-6, A-4	0-2	95-100	90-100	75-85	50-75	20-40	5-15
380--------------	0-11	Silt loam--------	CL, ML	A-6, A-4	0	100	95-100	90-100	70-90	30-40	5-15
Havana	11-22	Silty clay loam, loam, silt loam.	CL	A-6, A-7	0	100	95-100	90-100	70-85	30-45	10-20
	22-40	Loam, clay loam	CL	A-6	0-5	90-100	90-100	85-95	60-80	25-40	10-20
	40-60	Loam-------------	CL-ML, CL	A-6, A-4	0-5	90-100	90-100	85-95	60-75	25-40	5-15
381--------------	0-13	Silt loam--------	CL, ML	A-6, A-7	0	100	100	85-95	65-85	35-45	10-20
Newry	13-18	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	80-95	60-85	35-45	12-20
	18-42	Loam, clay loam	CL, ML	A-6, A-4, A-7	0-5	95-100	90-97	60-75	50-65	30-45	7-20
	42-60	Loam-------------	CL, ML	A-6, A-4	0-5	95-100	90-97	65-80	50-70	25-40	5-15
382B, 382C------- Blooming	0-8	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	90-95	60-85	25-40	5-20
	8-21	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-95	70-95	35-45	15-25
	21-45	Sandy loam, loam, clay loam.	CL, CL-ML, SC, SM-SC	A-6, A-4, A-7	0-5	95-100	90-100	70-90	40-80	25-45	5-20
	45-60	Loam-------------	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	65-80	50-70	25-40	5-15
393--------------	0-13	Silt loam--------	CL, ML	A-6, A-7	0	100	100	90-100	70-95	30-50	10-20
Udolpho	13-21	Silt loam, loam, silty clay loam.	CL, ML	A-6, A-7	0	100	100	90-100	70-95	30-50	10-20
	21-27	Loam, sandy clay loam, clay loam.	CL, ML	A-6, A-7	0-2	95-100	85-100	80-95	60-85	30-50	10-20
	27-60	Loamy coarse sand, sand, gravelly coarse sand.	SP, SP-SM, GP, GP-GM	A-1	0-3	45-90	35-85	20-45	0-10	---	NP
444--------------	0-15	Silty clay loam	CL	A-7, A-6	0	100	100	90-100	85-100	35-50	15-25
Canisteo	15-27	Silt loam, silty clay loam.	CL	A-6, A-7	0	98-100	90-100	85-95	65-85	38-50	25-35
	27-36	Clay loam, loam, sandy loam.	CL, ML, SM, SC	A-6, A-4	0-5	90-100	80-95	60-90	40-80	30-40	5-15
	36-60	Clay loam, loam	CL	A-6	0-5	95-100	90-98	80-95	50-75	30-40	12-20

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
465-------------- Kalmarville	0-10	Loam-------------	ML, CL, CL-ML	A-4	0	95-100	90-100	85-100	50-90	15-35	NP-10
	10-50	Fine sandy loam, sandy loam, silt loam.	ML, SM, SM-SC, CL-ML	A-4, A-2	0	95-100	90-100	60-85	30-60	15-25	NP-5
	50-60	Coarse sand, sand, loamy fine sand.	SP, SM, SW, SP-SM	A-3, A-2, A-1	0-2	90-100	85-100	40-80	2-30	<25	NP
467-------------- Sawmill	0-29	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-100	30-50	15-30
	29-36	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-100	30-50	15-30
	36-60	Silty clay loam, silt loam.	CL	A-4, A-6, A-7	0	100	100	75-100	65-95	20-50	8-30
479-------------- Floyd	0-17	Silt loam--------	OL, ML, CL	A-4, A-6	0	100	95-100	80-90	55-75	30-40	5-15
	17-39	Sandy clay loam, loam, sandy loam.	CL	A-6	2-8	90-95	70-80	50-70	50-65	25-35	11-20
	39-60	Loam, clay loam, sandy clay loam.	CL	A-6	2-5	90-95	85-95	70-85	50-65	25-35	11-20
483A, 483B------- Waukee	0-16	Loam-------------	CL	A-6	0	100	90-100	70-90	50-75	30-40	10-20
	16-27	Loam, sandy clay loam.	CL, SM-SC, SC, CL-ML	A-6, A-4	0-5	85-95	80-95	65-85	40-60	20-35	5-15
	27-60	Gravelly sand, gravelly loamy sand, loamy sand.	SW, SM, SP-SM, SP	A-1	2-10	60-90	60-85	20-40	3-25	---	NP
485-------------- Lawler	0-20	Silt loam--------	CL, ML	A-6, A-7	0	100	90-100	70-90	55-75	35-45	10-20
	20-32	Loam, sandy loam, clay loam.	CL, SC	A-6	0-5	85-95	80-95	70-85	45-65	25-40	10-20
	32-60	Gravelly coarse sand, gravelly loamy sand, loamy sand.	SW, GP, SP, SW-SM	A-1	2-10	50-90	50-85	20-40	3-10	---	NP
516A, 516B------- Dowagiac	0-10	Loam-------------	ML, CL-ML, CL	A-4	0	95-100	95-100	80-100	60-90	<30	2-10
	10-25	Clay loam, sandy loam, loam.	CL, SC	A-6, A-4	0	95-100	70-95	65-90	40-75	25-40	9-20
	25-30	Sandy loam, coarse sandy loam, gravelly coarse sandy loam.	SM, SM-SC, SC	A-2-4, A-1-b	0	80-100	60-85	40-60	15-30	<25	2-9
	30-60	Sand, loamy coarse sand, coarse sand.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2-4	0-10	50-90	25-90	10-55	0-10	---	NP
517-------------- Shandep	0-29	Clay loam--------	CL, CH	A-7	0	95-100	95-100	90-100	85-95	40-55	20-30
	29-36	Silty clay loam, clay loam, loam.	CL	A-7	0	95-100	95-100	90-100	85-95	40-50	20-30
	36-42	Sandy loam, gravelly sandy loam.	SM, SC, SM-SC	A-2, A-4	0	95-100	80-90	75-80	30-50	20-30	3-10
	42-60	Loamy sand, coarse sand, gravelly coarse sand.	SW, SP, SP-SM	A-1	0-5	65-90	60-90	20-45	2-5	---	NP

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
539	0-32	Muck	PT	A-8	---	---	---	---	---	---	---
Palms	32-60	Clay loam, silty clay loam, silt loam.	CL-ML, CL	A-4, A-6	0	85-100	80-100	70-95	50-90	25-40	5-20
631	0-21	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	85-95	55-75	25-35	5-15
Oran	21-48	Loam, clay loam, sandy clay loam.	CL	A-6	2-5	90-95	85-90	75-85	55-65	30-40	10-20
	48-60	Loam	CL	A-6	2-5	90-95	85-90	75-85	55-65	30-40	10-20
632	0-13	Silt loam	OL, CL, ML	A-6, A-7	0	100	95-100	90-95	70-85	35-50	11-20
Kensett Variant	13-24	Clay loam, loam	CL	A-6	2-5	90-95	85-95	80-90	55-70	30-40	15-25
	24-60	Channery silt loam, channery fine sandy loam, channery sandy loam.	GM, ML, SM	A-4, A-2	25-50	80-95	75-95	50-90	30-85	<40	NP-10
633B	0-7	Loam	CL, CL-ML	A-4	0-15	100	90-100	80-90	70-90	20-30	5-10
Nordness Variant	7-18	Clay loam, silty clay loam, loam.	CL	A-6	5-15	85-95	80-90	70-85	65-85	30-40	10-20
	18-60	Channery silt loam, very channery fine sandy loam, silt loam.	GM, SM, ML	A-4, A-2	30-75	70-85	65-85	40-80	30-75	<40	NP-10
634	0-13	Silt loam	MH, OH, ML, OL	A-7	0	100	100	85-95	60-75	45-55	15-20
Protivin	13-20	Loam, silt loam, clay loam.	CL	A-6	2-5	90-95	85-90	75-85	55-65	35-40	15-20
	20-60	Clay loam	CL	A-6	2-5	90-95	85-90	75-85	55-65	30-40	15-25
635	0-11	Silt loam	CL	A-6, A-7	0	100	100	85-95	60-75	35-45	15-20
Riceville	11-40	Loam, clay loam	CL	A-6	2-5	90-95	85-90	75-85	55-65	30-40	15-20
	40-60	Clay loam	CL	A-6	2-5	90-95	85-90	75-85	55-65	30-40	15-25
637	0-19	Silt loam	CL, CL-ML	A-4, A-6	0	100	95-100	80-90	55-75	25-40	5-15
Schley	19-28	Loam, sandy loam, silty clay loam.	CL, SC, SM-SC, CL-ML	A-2, A-4	2-8	90-95	70-80	50-70	20-60	20-30	5-10
	28-60	Loam, sandy clay loam, silt loam.	CL	A-6	2-5	90-95	85-95	70-85	50-65	25-40	10-20
638B, 638C	0-11	Silt loam	CL	A-4, A-6	0	100	95-100	85-95	55-70	25-35	8-15
Taopi	11-24	Loam, clay loam	CL	A-6	2-5	90-95	80-95	80-90	50-65	30-40	10-20
	24-30	Clay, clay loam, sandy clay loam.	CH	A-7	2-10	85-95	80-95	80-90	70-90	55-70	30-45
	30-60	Channery silt loam, cobbly fine sandy loam, cobbly silt loam.	SM, ML, CL, SC	A-4, A-2	25-50	80-95	75-95	50-90	30-85	20-40	NP-10
699A, 699B	0-15	Silt loam	CL	A-6	0-1	95-100	95-100	90-100	70-80	30-40	10-20
Rossfield	15-29	Silty clay loam, clay loam, loam.	CL	A-6	5-10	80-90	70-80	60-70	55-65	30-40	10-20
	29-60	Channery sandy loam, channery fine sandy loam, channery loam.	SM, SC, SM-SC	A-2, A-4	15-25	80-90	75-85	50-60	30-40	<20	2-8

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1013*. Pits											
1030*: Udorthents.											
Pits.											
1078. Udorthents											
1812-------------	0-23	Silt loam--------	CL	A-4, A-6	0-5	100	95-100	70-90	60-80	25-40	8-15
Terril	23-43	Loam, clay loam, sandy loam.	CL	A-4, A-6	0-5	100	90-100	70-90	60-80	25-40	8-15
	43-60	Gravelly loamy coarse sand, coarse sand.	SP-SM, SM	A-2-4	0-25	90-100	75-90	60-80	10-35	---	NP
1814B------------	0-14	Silt loam--------	CL	A-6, A-4	0	100	95-100	85-95	65-85	25-35	8-15
Waucoma	14-40	Loam, silt loam, sandy clay loam.	CL, SC	A-6	2-5	90-95	80-95	80-90	45-65	30-40	10-20
	40-45	Clay loam, clay	CH	A-7	2-10	85-95	80-95	80-90	70-90	55-70	30-45
	45-60	Channery silt loam, channery fine sandy loam, channery sandy loam.	ML, SM	A-4, A-2	25-50	80-95	75-95	50-90	30-85	<40	NP-10
1841-------------	0-13	Loam-------------	CL-ML, CL	A-6, A-4	0	100	100	90-98	70-90	25-40	6-15
Hayfield	13-28	Loam, silt loam, clay loam.	CL-ML, CL	A-4, A-6	0	95-100	95-100	70-90	65-80	25-40	6-15
	28-52	Coarse sand, gravelly coarse sand, sand.	SP, SP-SM	A-1	0-3	85-100	50-100	20-45	0-10	---	NP
	52-70	Sandy clay loam, loam, clay loam.	CL	A-6	0-5	90-95	85-95	80-90	50-70	25-35	10-20
1844-------------	0-12	Loam-------------	CL	A-6, A-4	0	100	95-100	85-95	55-75	25-35	8-15
Atkinson	12-43	Loam, clay loam, sandy clay loam.	CL	A-6	2-5	90-95	80-95	80-90	50-65	30-40	10-20
	43-45	Clay-------------	CH	A-7	2-10	85-95	80-95	80-90	70-90	55-70	30-45
	45-60	Channery silt loam, channery fine sandy loam, channery sandy loam.	ML, SM	A-4, A-2	25-50	80-95	75-95	50-90	30-85	<40	NP-10
1884-------------	0-7	Silt loam--------	CL, ML	A-6, A-7	0	100	100	85-95	70-90	30-45	10-20
Stateline	7-18	Silty clay loam, clay loam.	CL, ML	A-6, A-7	0	100	95-100	80-95	70-95	35-50	15-25
	18-60	Silty clay, clay	CH, CL	A-7	0-3	95-100	90-95	80-90	70-90	40-60	25-40
1891-------------	0-14	Silty clay loam	CL	A-7	0-10	95-100	85-100	85-100	80-95	40-50	15-25
Faxon Variant	14-37	Clay loam, silt loam, silty clay loam.	CL, ML	A-7, A-6	0-10	95-100	70-100	65-95	50-85	30-50	10-20
	37-60	Channery silt loam, channery fine sandy loam, channery sandy loam.	SM, ML	A-4, A-2	25-50	80-95	75-95	50-90	30-85	<35	NP-10

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1903, 1904------- Udolpho	0-8	Silt loam--------	CL, ML	A-6, A-7	0	100	100	90-100	70-95	30-50	10-20
	8-13	Silt loam, loam, silty clay loam.	CL, ML	A-6, A-7	0	100	100	90-100	70-95	30-50	10-20
	13-40	Loam, sandy clay loam, clay loam.	CL, ML	A-6, A-7	0-2	95-100	85-100	80-90	60-85	30-50	10-20
	40-64	Coarse sand, sand, gravelly coarse sand.	SP, SP-SM, GP, GP-GM	A-1	0-3	45-90	35-85	20-45	0-10	---	NP
	64-80	Loam, sandy clay loam.	CL	A-6	0-5	90-95	85-95	80-90	50-70	20-35	10-20
1905------------- Brownsdale	0-9	Silt loam--------	CL-ML, CL	A-6, A-4	0	100	95-100	85-100	70-95	20-40	4-20
	9-26	Silt loam, silty clay loam, clay loam.	CL	A-6, A-7	0	100	95-100	90-100	85-95	35-45	15-25
	26-48	Loam, sandy clay loam, clay loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0-3	90-100	85-95	65-95	40-85	25-40	5-20
	48-60	Loam, sandy clay loam.	CL, CL-ML, SC, SM-SC	A-6, A-4	0-1	90-100	85-100	65-90	40-70	25-40	5-20
1974*: Coland----------	0-10	Loam-------------	CL	A-6	0	100	95-100	85-95	60-75	30-40	10-20
	10-60	Clay loam, silty clay loam, loam.	CL	A-7, A-6	0	100	100	95-100	65-80	35-50	15-25
Spillville------	0-52	Loam-------------	CL	A-6	0	100	95-100	85-95	60-80	25-40	10-20
	52-60	Sandy clay loam, loam, sandy loam.	CL, CL-ML, SM-SC, SC	A-6, A-4	0	100	95-100	80-90	35-75	20-40	5-15
1992------------- Sargeant Variant	0-14	Silt loam--------	CL, ML	A-6	0	100	100	85-100	60-90	30-40	10-15
	14-32	Clay loam, loam, sandy clay loam.	CL, SC	A-6, A-7	0	100	95-100	80-95	45-75	30-45	10-25
	32-60	Silty clay, clay	CH, CL	A-7	0-3	95-100	90-95	80-95	70-90	45-60	20-35

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi-bility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
2A, 2B-----------	0-16	18-27	1.45-1.55	0.6-2.0	0.20-0.24	5.6-7.3	Low-----------	0.28	5	6	3-5
Ostrander	16-20	18-27	1.45-1.55	0.6-2.0	0.17-0.20	5.1-7.3	Low-----------	0.28			
	20-50	13-27	1.45-1.65	0.6-2.0	0.17-0.19	5.1-7.3	Low-----------	0.28			
	50-60	18-27	1.60-1.80	0.6-2.0	0.17-0.19	6.6-7.8	Low-----------	0.37			
23---------------	0-12	20-27	1.30-1.40	0.6-2.0	0.22-0.24	5.6-6.5	Low-----------	0.37	5	6	2-4
Skyberg	12-21	24-32	1.35-1.45	0.6-2.0	0.18-0.20	4.5-5.5	Moderate-----	0.37			
	21-50	20-27	1.60-1.80	0.2-0.6	0.14-0.19	5.1-7.3	Low-----------	0.37			
	50-60	20-27	1.75-1.95	0.2-0.6	0.09-0.13	7.4-7.8	Low-----------	0.37			
24B--------------	0-11	18-27	1.45-1.55	0.6-2.0	0.22-0.24	5.6-6.5	Low-----------	0.32	5	5	2-4
Kasson	11-16	24-32	1.45-1.55	0.6-2.0	0.18-0.22	4.5-6.0	Moderate-----	0.32			
	16-60	20-32	1.60-1.80	0.2-0.6	0.15-0.19	5.1-7.8	Moderate-----	0.32			
27A, 27B---------	0-16	10-18	1.50-1.55	2.0-6.0	0.12-0.15	5.6-7.3	Low-----------	0.20	4	3	1-2
Dickinson	16-30	10-15	1.45-1.55	2.0-6.0	0.12-0.15	5.1-6.5	Low-----------	0.20			
	30-40	4-10	1.55-1.65	6.0-20	0.08-0.10	5.1-6.5	Low-----------	0.20			
	40-60	4-10	1.60-1.70	6.0-20	0.02-0.04	5.6-7.3	Low-----------	0.15			
30B--------------	0-24	20-25	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.28	5	6	3-4
Kenyon	24-48	20-30	1.45-1.65	0.6-2.0	0.17-0.19	5.1-7.3	Low-----------	0.28			
	48-60	20-24	1.65-1.80	0.6-2.0	0.17-0.19	6.6-8.4	Low-----------	0.37			
44---------------	0-30	10-18	1.50-1.55	2.0-6.0	0.16-0.18	6.1-7.3	Low-----------	0.20	5	3	2-3
Ankeny	30-54	10-16	1.55-1.65	2.0-6.0	0.15-0.17	6.1-7.3	Low-----------	0.20			
	54-60	2-10	1.65-1.75	6.0-20	0.12-0.14	6.1-7.3	Low-----------	0.20			
79B--------------	0-7	7-15	1.40-1.70	2.0-6.0	0.13-0.18	5.6-7.8	Low-----------	0.20	5	3	1-2
Billett	7-24	10-18	1.40-1.70	2.0-6.0	0.10-0.15	5.1-7.3	Low-----------	0.20			
	24-36	8-18	1.50-1.80	2.0-6.0	0.05-0.12	5.6-7.3	Low-----------	0.20			
	36-60	2-7	1.60-1.90	6.0-20	0.02-0.10	5.1-7.8	Low-----------	0.10			
83---------------	0-22	28-32	1.30-1.45	0.6-2.0	0.18-0.22	6.1-7.3	High----------	0.28	5	7	6-9
Maxcreek	22-30	25-32	1.40-1.55	0.6-2.0	0.20-0.22	6.1-7.3	High----------	0.28			
	30-39	18-30	1.45-1.60	0.6-2.0	0.17-0.19	6.6-7.8	Moderate-----	0.28			
	39-60	18-27	1.50-1.70	0.6-2.0	0.17-0.19	7.4-7.8	Moderate-----	0.28			
88---------------	0-22	28-32	1.35-1.40	0.6-2.0	0.21-0.23	6.1-7.3	Moderate-----	0.28	5	7	9-11
Clyde	22-27	22-28	1.45-1.65	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.37			
	27-50	10-22	1.60-1.70	2.0-6.0	0.11-0.13	6.1-7.3	Low-----------	0.37			
	50-60	20-24	1.70-1.80	0.6-2.0	0.17-0.19	6.6-8.4	Moderate-----	0.37			
99A, 99B, 99C----	0-13	18-27	1.35-1.45	0.6-2.0	0.22-0.24	5.1-7.3	Low-----------	0.32	5	6	2-4
Racine	13-20	22-32	1.40-1.50	0.6-2.0	0.20-0.22	4.5-6.0	Moderate-----	0.32			
	20-45	18-32	1.55-1.65	0.6-2.0	0.15-0.19	4.5-6.0	Low-----------	0.32			
	45-60	18-27	1.65-1.80	0.6-2.0	0.16-0.19	6.6-7.8	Moderate-----	0.32			
129--------------	0-16	22-32	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.24	4	6	4-5
Cylinder	16-31	22-30	1.45-1.60	0.6-2.0	0.17-0.19	6.1-7.3	Moderate-----	0.32			
	31-60	2-12	1.60-1.70	>20	0.02-0.04	6.6-8.4	Low-----------	0.10			
135--------------	0-18	20-26	1.45-1.50	0.6-2.0	0.20-0.22	5.1-7.3	Low-----------	0.28	4	6	2-3
Donnan	18-29	20-30	1.45-1.55	0.6-2.0	0.17-0.19	5.1-5.5	Moderate-----	0.28			
	29-60	42-55	1.65-1.80	<0.06	0.11-0.14	5.1-6.5	High----------	0.28			
156A, 156B-------	0-15	18-30	1.25-1.40	0.6-2.0	0.22-0.24	5.6-7.3	Low-----------	0.32	4	6	3-6
Fairhaven	15-30	18-30	1.30-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.43			
	30-60	0-5	1.55-1.65	6.0-20	0.02-0.04	6.1-8.4	Low-----------	0.10			

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
190--------------	0-13	18-27	1.30-1.50	0.6-2.0	0.20-0.24	5.6-6.5	Low-----------	0.32	5	6	2-4
Hayfield	13-29	18-30	1.40-1.55	0.6-2.0	0.17-0.22	5.1-6.0	Low-----------	0.32			
	29-60	<5	1.55-1.65	6.0-20	0.02-0.04	5.6-7.8	Low-----------	0.15			
228B, 228C-------	0-7	16-22	1.45-1.55	0.6-2.0	0.16-0.18	6.6-8.4	Low-----------	0.28	2	6	.5-1
Mottland	7-60	10-15	1.60-1.90	2.0-6.0	0.08-0.10	6.6-8.4	Low-----------	0.10			
244A, 244B, 244C-	0-8	5-13	1.50-1.55	2.0-6.0	0.11-0.13	5.1-6.0	Low-----------	0.20	2	3	<1
Lilah	8-16	10-15	1.55-1.65	2.0-6.0	0.10-0.12	4.5-6.0	Low-----------	0.20			
	16-36	2-10	1.55-1.80	>20	0.02-0.04	4.5-6.0	Low-----------	0.20			
	36-60	2-6	1.55-1.85	>20	0.02-0.04	4.5-6.0	Low-----------	0.20			
252--------------	0-14	27-35	1.30-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.28	4	7	4-8
Marshan	14-26	25-35	1.40-1.55	0.6-2.0	0.17-0.22	5.6-7.3	Moderate-----	0.28			
	26-29	18-30	1.45-1.55	0.6-2.0	0.15-0.19	5.6-7.3	Low-----------	0.28			
	29-60	<5	1.55-1.65	6.0-20	0.02-0.05	6.1-7.3	Low-----------	0.15			
253--------------	0-18	28-32	1.30-1.45	0.6-2.0	0.18-0.22	6.1-7.3	High----------	0.28	5	7	6-8
Maxcreek	18-28	25-32	1.40-1.55	0.6-2.0	0.20-0.22	6.1-7.3	High----------	0.28			
	28-35	18-30	1.45-1.60	0.6-2.0	0.17-0.19	6.6-7.8	Moderate-----	0.28			
	35-60	18-27	1.50-1.70	0.6-2.0	0.17-0.19	7.4-7.8	Moderate-----	0.28			
255--------------	0-20	18-27	1.25-1.35	0.6-2.0	0.20-0.22	7.4-8.4	Low-----------	0.28	4	4L	4-8
Mayer	20-36	18-27	1.25-1.35	0.6-2.0	0.16-0.19	7.4-8.4	Low-----------	0.28			
	36-60	1-5	1.55-1.65	6.0-20	0.02-0.04	7.4-8.4	Low-----------	0.15			
295--------------	0-22	18-24	1.35-1.40	0.6-2.0	0.20-0.22	5.1-7.3	Low-----------	0.24	5	6	4-6
Readlyn	22-47	22-28	1.45-1.70	0.6-2.0	0.17-0.19	5.1-6.5	Low-----------	0.32			
	47-60	18-24	1.70-1.80	0.6-2.0	0.17-0.19	6.6-7.8	Low-----------	0.32			
307--------------	0-12	18-27	1.30-1.50	0.6-2.0	0.22-0.24	5.1-6.5	Low-----------	0.37	5	6	1-3
Sargeant	12-22	24-32	1.40-1.55	0.6-2.0	0.20-0.24	4.5-6.5	Moderate-----	0.37			
	22-45	20-32	1.60-1.80	0.06-0.2	0.10-0.15	4.5-6.5	Moderate-----	0.37			
	45-60	18-27	1.75-2.00	0.06-0.2	0.08-0.14	6.1-7.8	Low-----------	0.37			
313--------------	0-52	18-26	1.45-1.55	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.28	5	6	4-6
Spillville	52-60	14-24	1.55-1.70	0.6-6.0	0.15-0.18	5.6-7.3	Low-----------	0.28			
331--------------	0-23	28-32	1.40-1.45	0.6-2.0	0.19-0.21	6.1-7.3	Moderate-----	0.24	5	6	6-7
Tripoli	23-47	22-28	1.45-1.70	0.6-2.0	0.17-0.19	6.6-7.8	Low-----------	0.32			
	47-60	20-28	1.70-1.80	0.6-2.0	0.17-0.19	7.4-8.4	Low-----------	0.32			
334B-------------	0-11	18-27	1.30-1.50	0.6-2.0	0.22-0.24	5.6-6.5	Low-----------	0.37	5	5	1-3
Vlasaty	11-16	24-32	1.40-1.55	0.6-2.0	0.22-0.24	5.1-6.0	Low-----------	0.37			
	16-50	24-32	1.60-1.80	0.2-0.6	0.10-0.15	5.1-6.5	Moderate-----	0.37			
	50-60	18-32	1.75-2.00	0.2-0.6	0.08-0.14	7.4-8.4	Low-----------	0.37			
376B-------------	0-14	18-27	1.30-1.45	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.32	5	6	4-6
Moland	14-19	28-32	1.30-1.45	0.6-2.0	0.20-0.22	5.6-6.5	Moderate-----	0.32			
	19-45	18-30	1.35-1.50	0.6-2.0	0.17-0.19	5.6-7.3	Low-----------	0.32			
	45-60	18-27	1.50-1.70	0.6-2.0	0.17-0.19	6.6-7.8	Low-----------	0.32			
377--------------	0-16	18-27	1.30-1.45	0.6-2.0	0.22-0.24	5.6-7.3	Low-----------	0.32	5	6	4-6
Merton	16-23	18-30	1.35-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.32			
	23-60	18-27	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low-----------	0.32			
380--------------	0-11	18-27	1.30-1.45	0.6-2.0	0.22-0.24	5.6-7.3	Low-----------	0.32	5	6	2-4
Havana	11-22	24-32	1.35-1.50	0.2-0.6	0.15-0.19	5.6-6.5	Moderate-----	0.32			
	22-40	20-30	1.50-1.65	0.2-0.6	0.17-0.19	5.1-7.3	Moderate-----	0.32			
	40-60	18-27	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low-----------	0.32			

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
381--------------	0-13	18-27	1.30-1.45	0.6-2.0	0.24-0.30	5.6-6.5	Moderate-----	0.32	5	6	2-4
Newry	13-18	24-32	1.35-1.50	0.6-2.0	0.18-0.21	5.1-6.5	Moderate-----	0.32			
	18-42	20-30	1.50-1.65	0.6-2.0	0.17-0.19	5.6-7.3	Moderate-----	0.32			
	42-60	18-27	1.50-1.75	0.6-2.0	0.17-0.19	6.6-7.8	Low----------	0.32			
382B, 382C-------	0-8	18-27	1.30-1.45	0.6-2.0	0.24-0.30	5.6-6.5	Moderate-----	0.32	5	6	2-4
Blooming	8-21	24-32	1.35-1.50	0.6-2.0	0.18-0.22	5.6-6.5	Moderate-----	0.32			
	21-45	20-30	1.50-1.65	0.6-2.0	0.16-0.19	5.1-7.3	Moderate-----	0.32			
	45-60	18-27	1.50-1.70	0.6-2.0	0.17-0.19	6.6-7.8	Low----------	0.32			
393--------------	0-13	18-27	1.30-1.50	0.6-2.0	0.20-0.24	5.6-6.5	Low----------	0.32	5	6	2-4
Udolpho	13-21	18-30	1.40-1.55	0.6-2.0	0.16-0.22	5.1-6.5	Low----------	0.43			
	21-27	18-30	1.40-1.55	0.6-2.0	0.16-0.22	5.1-6.5	Low----------	0.43			
	27-60	0-5	1.55-1.65	6.0-20	0.02-0.08	5.6-7.8	Low----------	0.15			
444--------------	0-15	18-35	1.20-1.30	0.6-2.0	0.20-0.22	7.4-8.4	Moderate-----	0.32	5	4L	4-8
Canisteo	15-27	20-35	1.35-1.50	0.6-2.0	0.15-0.19	7.4-8.4	Moderate-----	0.32			
	27-36	10-35	1.30-1.50	0.6-6.0	0.12-0.18	7.4-8.4	Low----------	0.32			
	36-60	22-32	1.45-1.60	0.6-2.0	0.14-0.16	7.4-8.4	Low----------	0.32			
465--------------	0-10	13-23	1.35-1.45	0.6-2.0	0.20-0.24	6.6-7.8	Low----------	0.28	5	5	2-4
Kalmarville	10-50	8-18	1.40-1.50	2.0-6.0	0.13-0.18	6.6-7.8	Low----------	0.20			
	50-60	2-5	1.55-1.65	6.0-20	0.06-0.09	6.6-7.8	Low----------	0.10			
467--------------	0-29	27-35	1.20-1.40	0.6-2.0	0.21-0.23	6.1-7.8	Moderate-----	0.28	5	7	4-5
Sawmill	29-36	27-35	1.20-1.40	0.6-2.0	0.21-0.23	6.1-7.8	Moderate-----	0.28			
	36-60	18-35	1.35-1.50	0.6-2.0	0.15-0.19	6.1-8.4	Moderate-----	0.28			
479--------------	0-17	20-26	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.24	5	6	5-7
Floyd	17-39	18-24	1.40-1.60	0.6-2.0	0.16-0.18	6.1-7.3	Low----------	0.32			
	39-60	18-30	1.65-1.80	0.6-2.0	0.16-0.18	6.1-8.4	Low----------	0.32			
483A, 483B-------	0-16	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.1-7.3	Low----------	0.24	4	6	3-4
Waukee	16-27	18-27	1.40-1.50	0.6-2.0	0.15-0.19	5.1-6.0	Low----------	0.24			
	27-60	2-8	1.50-1.75	>20	0.02-0.06	5.6-6.5	Low----------	0.10			
485--------------	0-20	18-28	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	4	6	4-5
Lawler	20-32	10-28	1.45-1.60	0.6-2.0	0.16-0.18	5.1-6.5	Low----------	0.28			
	32-60	2-8	1.60-1.75	>20	0.02-0.04	5.1-7.3	Low----------	0.10			
516A, 516B-------	0-10	7-20	1.30-1.60	0.6-2.0	0.16-0.18	5.6-6.5	Low----------	0.28	4	5	1-3
Dowagiac	10-25	27-35	1.35-1.70	0.6-2.0	0.13-0.14	5.1-6.5	Moderate-----	0.28			
	25-30	5-20	1.35-1.70	2.0-6.0	0.14-0.15	5.1-6.5	Low----------	0.28			
	30-60	0-10	1.55-1.65	6.0-20	0.01-0.04	5.6-7.3	Low----------	0.15			
517--------------	0-29	26-32	1.35-1.40	0.6-2.0	0.20-0.23	6.1-7.8	Moderate-----	0.24	5	6	7-9
Shandep	29-36	26-32	1.40-1.60	0.6-2.0	0.17-0.20	6.1-7.8	Moderate-----	0.24			
	36-42	8-12	1.60-1.70	2.0-6.0	0.12-0.14	6.1-7.8	Low----------	0.24			
	42-60	2-8	1.60-1.70	6.0-20	0.02-0.04	6.1-8.4	Low----------	0.15			
539--------------	0-32	---	0.25-0.45	0.2-6.0	0.35-0.45	5.1-7.8	-------------	----	2	2	>75
Palms	32-60	7-35	1.45-1.75	0.2-2.0	0.14-0.22	6.1-8.4	Low----------	----			
631--------------	0-21	16-24	1.40-1.45	0.6-2.0	0.18-0.20	5.1-7.3	Low----------	0.28	5	6	2-3
Oran	21-48	22-28	1.45-1.70	0.6-2.0	0.17-0.19	4.5-6.5	Low----------	0.28			
	48-60	20-26	1.70-1.80	0.6-2.0	0.17-0.19	7.4-7.8	Low----------	0.37			
632--------------	0-13	24-29	1.20-1.40	0.6-2.0	0.21-0.23	6.1-7.3	Moderate-----	0.28	3	6	5-6
Kensett Variant	13-24	22-29	1.40-1.60	0.6-2.0	0.17-0.19	6.1-7.3	Moderate-----	0.28			
	24-60	15-20	1.40-1.90	2.0-6.0	0.10-0.19	7.4-8.4	Low----------	0.10			

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
633B	0-7	18-24	1.20-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.43	2	6	1-2
Nordness Variant	7-18	22-30	1.50-1.80	0.6-2.0	0.15-0.19	5.6-7.3	Moderate	0.43			
	18-60	10-15	1.40-1.90	2.0-6.0	0.10-0.15	7.4-8.4	Low	0.10			
634	0-13	20-30	1.45-1.50	0.6-2.0	0.18-0.20	5.1-7.3	Moderate	0.28	5	6	5-7
Protivin	13-20	20-30	1.50-1.60	0.2-0.6	0.17-0.19	5.1-6.0	Moderate	0.37			
	20-60	28-35	1.60-1.90	0.2-0.6	0.15-0.17	5.6-7.8	Moderate	0.37			
635	0-11	22-27	1.45-1.50	0.6-2.0	0.18-0.20	4.5-7.3	Moderate	0.32	4	6	3-4
Riceville	11-40	24-33	1.50-1.60	0.2-0.6	0.17-0.19	4.5-6.0	Moderate	0.32			
	40-60	30-35	1.60-1.85	0.2-0.6	0.15-0.17	4.5-7.8	Moderate	0.32			
637	0-19	18-22	1.40-1.45	0.6-2.0	0.19-0.21	4.5-6.5	Moderate	0.32	5	6	2-3
Schley	19-28	15-28	1.45-1.65	0.6-2.0	0.12-0.16	4.5-5.5	Low	0.32			
	28-60	20-28	1.65-1.80	0.6-2.0	0.16-0.18	5.1-7.8	Low	0.32			
638B, 638C	0-11	18-24	1.20-1.45	0.6-2.0	0.19-0.21	5.6-7.3	Low	0.28	4	6	2-3
Taopi	11-24	20-35	1.50-1.70	0.6-2.0	0.17-0.19	5.1-7.3	Moderate	0.28			
	24-30	30-55	1.50-1.70	0.6-2.0	0.12-0.15	6.1-7.3	High	0.28			
	30-60	15-20	1.40-1.80	2.0-6.0	0.10-0.19	7.4-8.4	Low	0.10			
699A, 699B	0-15	22-26	1.40-1.45	0.6-2.0	0.21-0.23	6.1-7.3	Low	0.32	4	6	3-4
Rossfield	15-29	25-32	1.50-1.70	0.6-2.0	0.18-0.20	6.1-7.3	Low	0.32			
	29-60	10-15	1.70-1.90	2.0-6.0	0.10-0.12	7.4-8.4	Low	0.10			
1013*. Pits											
1030*: Udorthents.											
Pits.											
1078. Udorthents											
1812	0-23	20-26	1.35-1.40	0.6-2.0	0.20-0.22	5.1-7.3	Low	0.32	5	6	4-5
Terril	23-43	17-30	1.40-1.65	0.6-2.0	0.16-0.18	5.1-7.3	Low	0.32			
	43-60	2-8	1.65-1.75	6.0-20	0.05-0.07	5.6-8.4	Low	0.10			
1814B	0-14	18-24	1.20-1.40	0.6-2.0	0.19-0.21	5.6-7.3	Low	0.28	4	6	2-3
Waucoma	14-40	20-27	1.50-1.70	0.6-2.0	0.17-0.19	5.6-6.5	Moderate	0.28			
	40-45	38-55	1.70-1.80	0.06-0.2	0.12-0.15	5.6-7.3	High	0.28			
	45-60	15-20	1.40-1.90	2.0-6.0	0.10-0.19	7.4-8.4	Low	0.10			
1841	0-13	18-27	1.30-1.50	0.6-2.0	0.20-0.24	5.6-6.5	Low	0.32	5	6	2-4
Hayfield	13-28	18-30	1.40-1.55	0.6-2.0	0.17-0.22	5.1-6.0	Low	0.32			
	28-52	0-5	1.55-1.65	6.0-20	0.02-0.04	5.6-7.8	Low	0.15			
	52-70	18-32	1.65-2.00	0.6-2.0	0.17-0.19	5.6-7.8	Low	0.37			
1844	0-12	18-24	1.20-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	4	6	3-5
Atkinson	12-43	24-32	1.45-1.75	0.6-2.0	0.17-0.19	5.1-7.3	Low	0.28			
	43-45	40-50	1.75-1.85	0.06-0.2	0.12-0.15	6.6-7.3	High	0.28			
	45-60	15-20	1.40-1.90	2.0-6.0	0.10-0.19	7.4-8.4	Low	0.10			
1884	0-7	18-27	1.30-1.50	0.6-2.0	0.20-0.24	5.6-7.3	Low	0.32	4	6	3-6
Stateline	7-18	22-35	1.50-1.70	0.2-2.0	0.17-0.19	4.5-6.0	Moderate	0.32			
	18-60	35-55	1.75-2.00	<0.06	0.11-0.14	4.5-6.0	High	0.32			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
1891------------- Faxon Variant	0-14	28-35	1.10-1.40	0.6-2.0	0.17-0.22	6.6-7.8	Moderate-----	0.28	4	6	5-15
	14-37	18-30	1.40-1.60	0.6-2.0	0.12-0.19	6.6-7.8	Moderate-----	0.28			
	37-60	15-20	1.40-1.90	2.0-6.0	0.10-0.19	7.4-8.4	Low----------	0.10			
1903, 1904------- Udolpho	0-8	18-27	1.30-1.50	0.6-2.0	0.20-0.24	5.6-6.5	Low----------	0.37	5	6	2-4
	8-13	18-30	1.40-1.55	0.6-2.0	0.16-0.22	5.1-6.5	Low----------	0.43			
	13-40	18-30	1.40-1.55	0.6-2.0	0.16-0.22	5.1-6.5	Low----------	0.43			
	40-64	0-5	1.55-1.65	6.0-20	0.02-0.08	5.6-7.8	Low----------	0.15			
	64-80	18-27	1.65-2.00	0.2-2.0	0.14-0.18	6.6-7.8	Low----------	0.37			
1905------------- Brownsdale	0-9	18-30	1.30-1.50	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.32	5	6	2-4
	9-26	22-35	1.45-1.55	0.6-2.0	0.17-0.19	4.5-6.5	Moderate-----	0.32			
	26-48	18-30	1.55-1.70	0.2-0.6	0.15-0.19	4.5-6.5	Low----------	0.32			
	48-60	18-27	1.70-2.00	0.2-0.6	0.08-0.13	6.6-7.8	Low----------	0.32			
1974*:											
Coland----------	0-10	22-26	1.40-1.45	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.28	5	6	5-7
	10-60	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.28			
Spillville------	0-52	18-26	1.45-1.55	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.28	5	6	4-6
	52-60	14-24	1.55-1.70	0.6-6.0	0.15-0.18	5.6-7.3	Low----------	0.28			
1992------------- Sargeant Variant	0-14	18-26	1.30-1.50	0.6-2.0	0.20-0.24	5.1-7.3	Low----------	0.32	5	6	2-4
	14-32	22-35	1.50-1.70	0.2-2.0	0.17-0.19	4.5-6.0	Moderate-----	0.32			
	32-60	40-55	1.75-2.00	<0.06	0.05-0.09	5.6-7.3	High---------	0.32			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "frequent," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Total Subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
					Ft			In			
2A, 2B------------ Ostrander	B	None---------	---	---	>6.0	---	---	---	Moderate	Moderate	Low.
23---------------- Skyberg	C	None---------	---	---	1.0-3.0	Perched	Nov-Jun	---	High-----	High-----	Moderate.
24B--------------- Kasson	C	None---------	---	---	2.0-3.0	Perched	Nov-May	---	High-----	High-----	Moderate.
27A, 27B---------- Dickinson	B	None---------	---	---	>6.0	---	---	---	Moderate	Low------	Moderate.
30B--------------- Kenyon	B	None---------	---	---	>6.0	---	---	---	Moderate	Moderate	Moderate.
44---------------- Ankeny	B	Occasional	Very brief	Feb-Nov	>6.0	---	---	---	Moderate	Low------	Low.
79B--------------- Billett	B	None---------	---	---	>6.0	---	---	---	Moderate	Low------	Moderate.
83---------------- Maxcreek	B/D	None---------	---	---	+1-2.0	Apparent	Jan-Dec	---	High-----	High-----	Low.
88---------------- Clyde	B/D	None---------	---	---	1.0-2.5	Apparent	Nov-Jul	---	High-----	High-----	Low.
99A, 99B, 99C----- Racine	B	None---------	---	---	>6.0	---	---	---	Moderate	Low------	Moderate.
129--------------- Cylinder	B	None---------	---	---	2.0-4.0	Apparent	Nov-Jul	---	High-----	Moderate	Low.
135--------------- Donnan	C	None---------	---	---	2.0-3.0	Perched	Nov-Jul	---	High-----	High-----	Moderate.
156A, 156B-------- Fairhaven	B	None---------	---	---	>6.0	---	---	---	Moderate	Low------	Moderate.
190--------------- Hayfield	B	None---------	---	---	2.5-5.0	Apparent	Nov-Jun	---	High-----	Low------	Moderate.
228B, 228C-------- Mottland	B	None---------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Total Subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
					Ft			In			
244A, 244B, 244C-- Lilah	A	None	---	---	>6.0	---	---	---	Low	Low	High.
252 Marshan	B/D	None	---	---	1.0-2.5	Apparent	Oct-Jun	---	High	High	Moderate.
253 Maxcreek	B/D	None	---	---	1.0-3.0	Apparent	Nov-Jun	---	High	High	Low.
255 Mayer	B/D	None	---	---	1.0-3.0	Apparent	Oct-Jun	---	High	High	Low.
295 Readlyn	B	None	---	---	2.0-4.0	Apparent	Nov-Jul	---	High	High	Moderate.
307 Sargeant	D	None	---	---	0.5-1.5	Perched	Mar-Jun	---	High	Moderate	High.
313 Spillville	B	Occasional	Very brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	---	Moderate	High	Moderate.
331 Tripoli	B/D	None	---	---	1.0-2.0	Apparent	Nov-Jul	---	High	High	Moderate.
334B Vlasaty	C	None	---	---	1.5-3.0	Perched	Mar-May	---	High	Moderate	Moderate.
376B Moland	B	None	---	---	>6.0	---	---	---	Moderate	Low	Moderate.
377 Merton	B	None	---	---	2.0-5.0	Apparent	Nov-Jun	---	High	Low	Moderate.
380 Havana	B	None	---	---	1.0-3.0	Apparent	Nov-Jun	---	High	High	Moderate.
381 Newry	B	None	---	---	2.0-5.0	Apparent	Nov-Jun	---	High	Moderate	Moderate.
382B, 382C Blooming	B	None	---	---	>6.0	---	---	---	Moderate	Moderate	Moderate.
393 Udolpho	B/D	None	---	---	1.0-3.0	Apparent	Oct-Jun	---	High	High	Moderate.
444 Canisteo	B/D	None	---	---	1.0-3.0	Apparent	Oct-Jul	---	High	High	Low.
465 Kalmarville	B/D	Frequent	Brief	Mar-Jun	0-1.0	Apparent	Nov-Aug	---	High	Moderate	Low.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Total Subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
					Ft			In			
467---------------- Sawmill	B/D	Frequent----	Brief to long.	Mar-Jun	0-2.0	Apparent	Mar-Jun	---	High-----	High-----	Low.
479---------------- Floyd	B	None---------	---	---	2.0-4.0	Apparent	Nov-Jun	---	High-----	High-----	Low.
483A, 483B--------- Waukee	B	None---------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.
485---------------- Lawler	B	None---------	---	---	2.0-4.0	Apparent	Nov-May	---	High-----	High-----	Moderate.
516A, 516B--------- Dowagiac	B	None---------	---	---	>6.0	---	---	---	Moderate	Low------	Moderate.
517---------------- Shandep	B/D	None---------	---	---	+1-1.0	Apparent	Jan-Dec	---	High-----	High-----	Moderate.
539---------------- Palms	A/D	None---------	---	---	+1-1.0	Apparent	Nov-May	25-32	High-----	High-----	Moderate.
631---------------- Oran	B	None---------	---	---	2.0-4.0	Apparent	Nov-Jul	---	High-----	High-----	Moderate.
632---------------- Kensett Variant	B	None---------	---	---	2.0-4.0	Apparent	Nov-Jul	---	High-----	High-----	Low.
633B--------------- Nordness Variant	B	None---------	---	---	>6.0	---	---	---	Low------	Low------	Low.
634---------------- Protivin	C	None---------	---	---	2.0-4.0	Apparent	Nov-Jul	---	High-----	High-----	Moderate.
635---------------- Riceville	C	None---------	---	---	2.0-4.0	Apparent	Nov-Jul	---	High-----	High-----	Moderate.
637---------------- Schley	B	None---------	---	---	1.0-3.0	Apparent	Nov-Jul	---	High-----	High-----	High.
638B, 638C--------- Taopi	B	None---------	---	---	>6.0	---	---	---	Moderate	Moderate	Moderate.
699A, 699B--------- Rossfield	B	None---------	---	---	>6.0	---	---	---	Moderate	Low------	Moderate.
1013*. Pits											

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Total Subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
					Ft			In			
1030*: Udorthents.											
Pits.											
1078. Udorthents											
1812 Terril	B	None	---	---	>6.0	---	---	---	Moderate	Moderate	Low.
1814B Waucoma	B	None	---	---	>6.0	---	---	---	Moderate	Moderate	Moderate.
1841 Hayfield	B	None	---	---	2.5-5.0	Perched	Apr-Jun	---	High	Low	Moderate.
1844 Atkinson	B	None	---	---	>6.0	---	---	---	Moderate	Moderate	Moderate.
1884 Stateline	D	None	---	---	0-2.0	Perched	Apr-Jun	---	High	Moderate	Moderate.
1891 Faxon Variant	B/D	None	---	---	1.0-3.0	Apparent	Nov-May	---	High	High	Low.
1903 Udolpho	B/D	None	---	---	+1-2.0	Apparent	Oct-Jun	---	High	Moderate	Moderate.
1904 Udolpho	B/D	None	---	---	1.0-3.0	Apparent	Oct-Jun	---	High	Low	Moderate.
1905 Brownsdale	C	None	---	---	0-3.0	Perched	Apr-Jun	---	High	High	Moderate.
1974*: Coland	B/D	Frequent	Brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	---	High	High	Low.
Spillville	B	Frequent	Very brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	---	Moderate	High	Moderate.
1992 Sargeant Variant	D	None	---	---	1.0-3.0	Perched	Apr-Jun	---	High	Moderate	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Ankeny	Coarse-loamy, mixed, mesic Cumulic Hapludolls
*Atkinson	Fine-loamy, mixed, mesic Typic Argiudolls
Billett	Coarse-loamy, mixed, mesic Mollic Hapludalfs
Blooming	Fine-loamy, mixed, mesic Mollic Hapludalfs
Brownsdale	Fine-loamy, mixed, mesic Mollic Ochraqualfs
Canisteo	Fine-loamy, mixed (calcareous), mesic Typic Haplaquolls
Clyde	Fine-loamy, mixed, mesic Typic Haplaquolls
Coland	Fine-loamy, mixed, mesic Cumulic Haplaquolls
Cylinder	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aquic Hapludolls
Dickinson	Coarse-loamy, mixed, mesic Typic Hapludolls
Donnan	Fine-loamy over clayey, mixed, mesic Aquollic Hapludalfs
Dowagiac	Fine-loamy, mixed, mesic Mollic Hapludalfs
Fairhaven	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls
Faxon Variant	Fine-loamy, mixed, mesic Typic Haplaquolls
Floyd	Fine-loamy, mixed, mesic Aquic Hapludolls
Havana	Fine-loamy, mixed, mesic Mollic Ochraqualfs
Hayfield	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aquollic Hapludalfs
Kalmarville	Coarse-loamy, mixed, nonacid, mesic Mollic Fluvaquents
Kasson	Fine-loamy, mixed, mesic Aquollic Hapludalfs
Kensett Variant	Fine-loamy, mixed, mesic Aquic Hapludolls
Kenyon	Fine-loamy, mixed, mesic Typic Hapludolls
Lawler	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aquic Hapludolls
Lilah	Sandy, mixed, mesic Psammentic Hapludalfs
Marshan	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Haplaquolls
Maxcreek	Fine-silty, mixed, mesic Typic Haplaquolls
Mayer	Fine-loamy over sandy or sandy-skeletal, mixed (calcareous), mesic Typic Haplaquolls
Merton	Fine-loamy, mixed, mesic Aquic Hapludolls
Moland	Fine-loamy, mixed, mesic Typic Hapludolls
*Mottland	Coarse-loamy, carbonatic, mesic Entic Hapludolls
Newry	Fine-loamy, mixed, mesic Aquollic Hapludalfs
Nordness Variant	Fine-loamy, mixed, mesic Typic Argiudolls
Oran	Fine-loamy, mixed, mesic Aquollic Hapludalfs
Ostrander	Fine-loamy, mixed, mesic Typic Hapludolls
Palms	Loamy, mixed, euic, mesic Terric Medisaprists
Protivin	Fine-loamy, mixed, mesic Aquic Argiudolls
Racine	Fine-loamy, mixed, mesic Mollic Hapludalfs
Readlyn	Fine-loamy, mixed, mesic Aquic Hapludolls
Riceville	Fine-loamy, mixed, mesic Udollic Ochraqualfs
Rossfield	Fine-loamy, mixed, mesic Typic Hapludolls
Sargeant	Fine-loamy, mixed, mesic Aeric Glossaqualfs
Sargeant Variant	Fine-loamy, mixed, mesic Udollic Ochraqualfs
Sawmill	Fine-silty, mixed, mesic Cumulic Haplaquolls
Schley	Fine-loamy, mixed, mesic Udollic Ochraqualfs
Shandep	Fine-loamy, mixed, mesic Cumulic Haplaquolls
Skyberg	Fine-loamy, mixed, mesic Udollic Ochraqualfs
Spillville	Fine-loamy, mixed, mesic Cumulic Hapludolls
Stateline	Fine, montmorillonitic, mesic Mollic Ochraqualfs
Taopi	Fine-loamy, mixed, mesic Mollic Hapludalfs
*Terril	Fine-loamy, mixed, mesic Cumulic Hapludolls
Tripoli	Fine-loamy, mixed, mesic Typic Haplaquolls
Udolpho	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Mollic Ochraqualfs
Udorthents	Loamy, mixed, mesic Udorthents
Vlasaty	Fine-loamy, mixed, mesic Glossaquic Hapludalfs
Waucoma	Fine-loamy, mixed, mesic Mollic Hapludalfs
Waukee	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls

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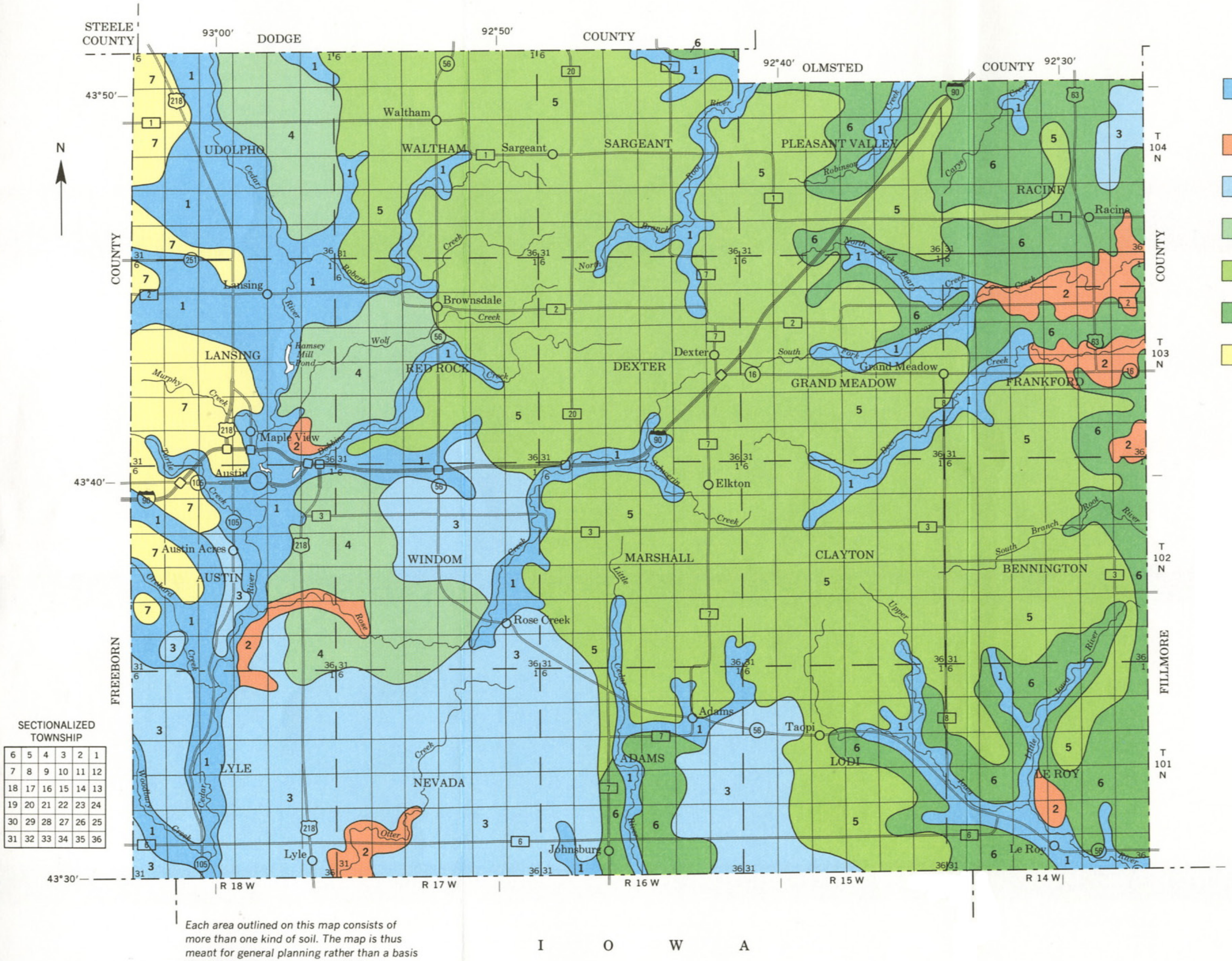

STEELE COUNTY
DODGE COUNTY
OLMSTED COUNTY
FREEBORN COUNTY
FILLMORE COUNTY
I O W A
93°00'
92°50'
92°40'
92°30'
43°50'
43°40'
43°30'
N
T 104 N
T 103 N
T 102 N
T 101 N
R 18 W
R 17 W
R 16 W
R 15 W
R 14 W
UDOLPHO
WALTHAM
SARGEANT
PLEASANT VALLEY
RACINE
LANSING
RED ROCK
DEXTER
GRAND MEADOW
FRANKFORD
WINDOM
MARSHALL
CLAYTON
BENNINGTON
AUSTIN
LYLE
NEVADA
ADAMS
LODI
LE ROY
Waltham
Sargeant
Racine
Lansing
Brownsdale
Dexter
Grand Meadow
Maple View
Austin
Elkton
Austin Acres
Rose Creek
Adams
Taopi
Johnsburg
Lyle
Le Roy
Ramsey Mill Pond
Cedar River
Roberts Creek
Wolf Creek
Murphy Creek
Dobbins Creek
Turtle Creek
Orchard Creek
Rose Creek
Otter Creek
Woodbury Creek
Little Cedar River
Robinson Creek
Cross Creek
North Branch Root River
North Bear Creek
South Fork Bear Creek
Deer Creek
Schwerin Creek
Upper Iowa River
Little Iowa River
South Branch Root River
SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

LEGEND*

1	**MARSHAN-WAUKEE-HAYFIELD** association: Nearly level and gently sloping, poorly drained to well drained, loamy soils on outwash plains and stream terraces
2	**ROSSFIELD-TAOPI-FAXON VARIANT** association: Nearly level and gently sloping, well drained and poorly drained, silty soils on uplands
3	**UDOLPHO-SCHLEY-CLYDE** association: Nearly level, somewhat poorly drained and poorly drained, silty soils on outwash plains, stream terraces, and till plains
4	**SARGEANT-BROWNSDALE** association: Nearly level, somewhat poorly drained and poorly drained, silty soils on till plains
5	**TRIPOLI-ORAN-READLYN** association: Nearly level and gently sloping, poorly drained and somewhat poorly drained, silty soils on till plains
6	**CLYDE-FLOYD-RACINE** association: Nearly level to sloping, poorly drained, somewhat poorly drained, and well drained, silty soils on till plains
7	**BLOOMING-MAXCREEK-HAVANA** association: Nearly level to moderately steep, well drained, poorly drained, and very poorly drained, silty soils on moraines

* Texture terms in the descriptive headings refer to the surface layer of the major soils in the associations.

COMPILED 1988

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
MINNESOTA AGRICULTURAL EXPERIMENT STATION

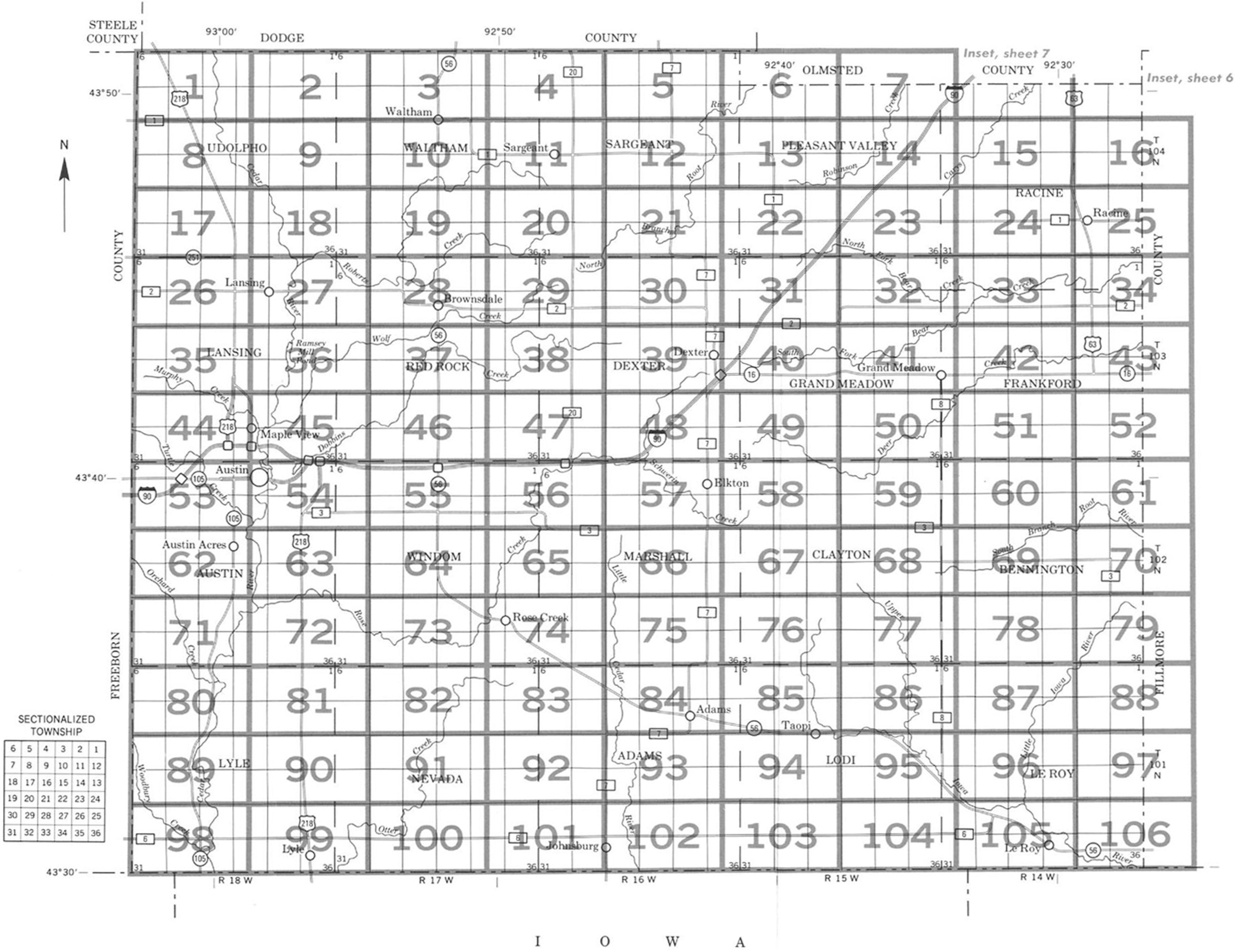
GENERAL SOIL MAP

MOWER COUNTY, MINNESOTA

Scale 1:190,080

1 0 1 2 3 Miles

1 0 3 6 Km


STEELE COUNTY
DODGE COUNTY
OLMSTED COUNTY
FREEBORN COUNTY
FILLMORE COUNTY
I O W A
93°00′
92°50′
92°40′
92°30′
43°50′
43°40′
43°30′
N
Inset, sheet 7
Inset, sheet 6
T 104 N
T 103 N
T 102 N
T 101 N
R 18 W
R 17 W
R 16 W
R 15 W
R 14 W
UDOLPHO
WALTHAM
SARGEANT
PLEASANT VALLEY
RACINE
LANSING
RED ROCK
DEXTER
GRAND MEADOW
FRANKFORD
AUSTIN
WINDOM
MARSHALL
CLAYTON
BENNINGTON
LYLE
NEVADA
ADAMS
LODI
LE ROY
Waltham
Sargeant
Racine
Lansing
Brownsdale
Dexter
Grand Meadow
Maple View
Austin
Elkton
Austin Acres
Rose Creek
Adams
Taopi
Lyle
Johnsburg
Le Roy
Cedar River
Root River
North Branch
North Fork
Bear Creek
Roberts Creek
Wolf Creek
Ramsey Mill Pond
Murphy Creek
Dobbins Creek
Turtle Creek
South Fork
Deer Creek
Schwerin Creek
South Branch
Orchard Creek
Rose Creek
Little Cedar River
Upper Iowa River
Little Iowa River
Woodbury Creek
Otter Creek
Robinson Creek
Carey Creek
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106
SECTIONALIZED TOWNSHIP
6 5 4 3 2 1
7 8 9 10 11 12
18 17 16 15 14 13
19 20 21 22 23 24
30 29 28 27 26 25
31 32 33 34 35 36

INDEX TO MAP SHEETS
MOWER COUNTY, MINNESOTA

Scale 1:190,080

1 0 1 2 3 Miles
1 0 3 6 Km

SOIL LEGEND

Map symbols consist of numbers or a combination of numbers and a letter. The initial numbers represent the kind of soil. A capital letter following the numbers indicates the class of slope.

SYMBOL	NAME
2A	Ostrander loam, 0 to 2 percent slopes
2B	Ostrander loam, 2 to 6 percent slopes
23	Skyberg silt loam
24B	Kasson silt loam, 1 to 4 percent slopes
27A	Dickinson fine sandy loam, 0 to 2 percent slopes
27B	Dickinson fine sandy loam, 2 to 6 percent slopes
30B	Kenyon silt loam, 1 to 6 percent slopes
44	Ankeny fine sandy loam
79B	Billett fine sandy loam, 2 to 6 percent slopes
83	Maxcreek silty clay loam, swales
88	Clyde silty clay loam
99A	Racine silt loam, 0 to 2 percent slopes
99B	Racine silt loam, 2 to 6 percent slopes
99C	Racine silt loam, 6 to 12 percent slopes
129	Cylinder loam
135	Donnan silt loam
156A	Fairhaven silt loam, 0 to 2 percent slopes
156B	Fairhaven silt loam, 2 to 6 percent slopes
190	Hayfield loam
228B	Mottland loam, 2 to 6 percent slopes
228C	Mottland loam, 6 to 12 percent slopes
244A	Lilah sandy loam, 0 to 2 percent slopes
244B	Lilah sandy loam, 2 to 6 percent slopes
244C	Lilah sandy loam, 6 to 12 percent slopes
252	Marshan clay loam
253	Maxcreek silty clay loam
255	Mayer loam
295	Readlyn silt loam
307	Sargeant silt loam
313	Spillville loam, occasionally flooded
331	Tripoli silty clay loam
334B	Vlasaty silt loam, 1 to 4 percent slopes
376B	Moland silt loam, 1 to 6 percent slopes
377	Merton silt loam
380	Havana silt loam
381	Newry silt loam
382B	Blooming silt loam, 2 to 6 percent slopes
382C	Blooming silt loam, 6 to 15 percent slopes
393	Udolpho silt loam
444	Canisteo silty clay loam
465	Kalmarville loam, frequently flooded
467	Sawmill silty clay loam
479	Floyd silt loam
483A	Waukee loam, 0 to 2 percent slopes
483B	Waukee loam, 2 to 6 percent slopes
485	Lawler silt loam
516A	Dowagiac loam, 0 to 2 percent slopes
516B	Dowagiac loam, 2 to 6 percent slopes
517	Shandep clay loam
539	Palms muck
631	Oran silt loam, 1 to 4 percent slopes
632	Kensett Variant silt loam
633B	Nordness Variant loam, 2 to 6 percent slopes
634	Protivin silt loam
635	Riceville silt loam
637	Schley silt loam
638B	Taopi silt loam, 1 to 6 percent slopes
638C	Taopi silt loam, 6 to 12 percent slopes
699A	Rossfield silt loam, 0 to 2 percent slopes
699B	Rossfield silt loam, 2 to 6 percent slopes
1013	Pits, quarry
1030	Udorthents-Pits complex
1078	Udorthents, nearly level to sloping
1812	Terril silt loam
1814B	Waucoma silt loam, 1 to 6 percent slopes
1841	Hayfield loam, loamy substratum
1844	Atkinson loam
1884	Stateline silt loam
1891	Faxon Variant silty clay loam
1903	Udolpho silt loam, loamy substratum, swales
1904	Udolpho silt loam, loamy substratum
1905	Brownsdale silt loam
1974	Coland-Spillville loams, frequently flooded
1992	Sargeant Variant silt loam

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

National, state or province

County or parish

Reservation (national forest or park, state forest or park, and large airport)

Field sheet matchline & neatline

AD HOC BOUNDARY (label)

Small airport, airfield, park, oilfield, cemetery, or flood pool — Davis Airstrip; FLOOD POOL LINE

STATE COORDINATE TICK — 250 000 FEET

LAND DIVISION CORNERS (sections and land grants)

ROAD EMBLEMS & DESIGNATIONS

Interstate — 90

Federal — 218

State — 56

RAILROAD

DAMS

Medium or small — water; w

PITS

Gravel pit — ⚒

Mine or quarry — ⚒

WATER FEATURES

DRAINAGE

Perennial, double line

Perennial, single line

Intermittent

Drainage end

Canals or ditches

Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

Perennial — water; w

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — 631 331

ESCARPMENTS

Other than bedrock (points down slope)

SHORT STEEP SLOPE — ....

MISCELLANEOUS

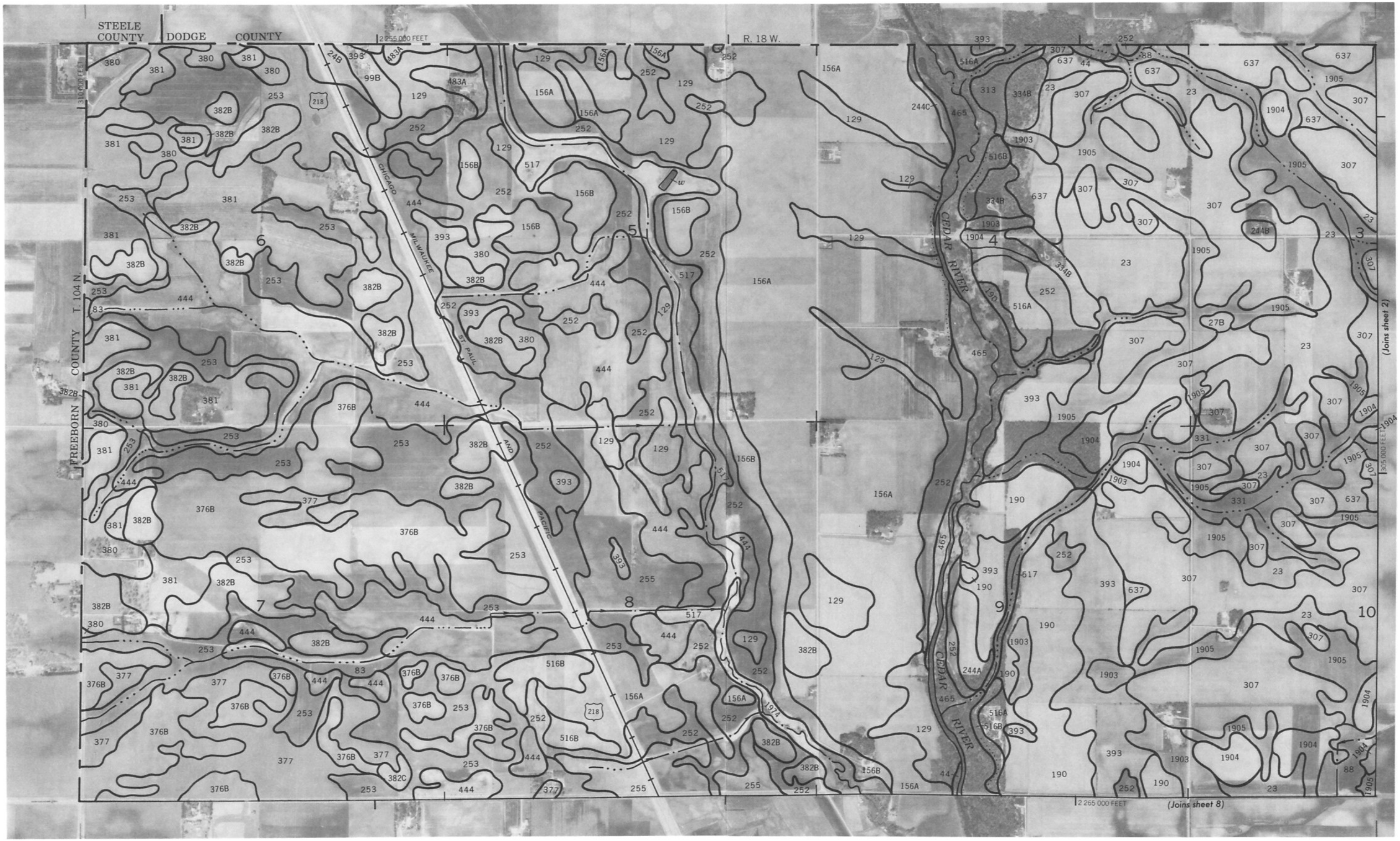
Gravelly spot — ∘°

Rock outcrop (includes sandstone and shale) — ▾

Sandy spot — ⁙

Sink hole — ⚹

MOWER COUNTY, MINNESOTA — SHEET NUMBER 1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DODGE COUNTY
FREEBORN COUNTY
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R. 18 W.
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305 000 FEET
310 000 FEET
CHICAGO MILWAUKEE ST PAUL AND PACIFIC
218
CEDAR RIVER
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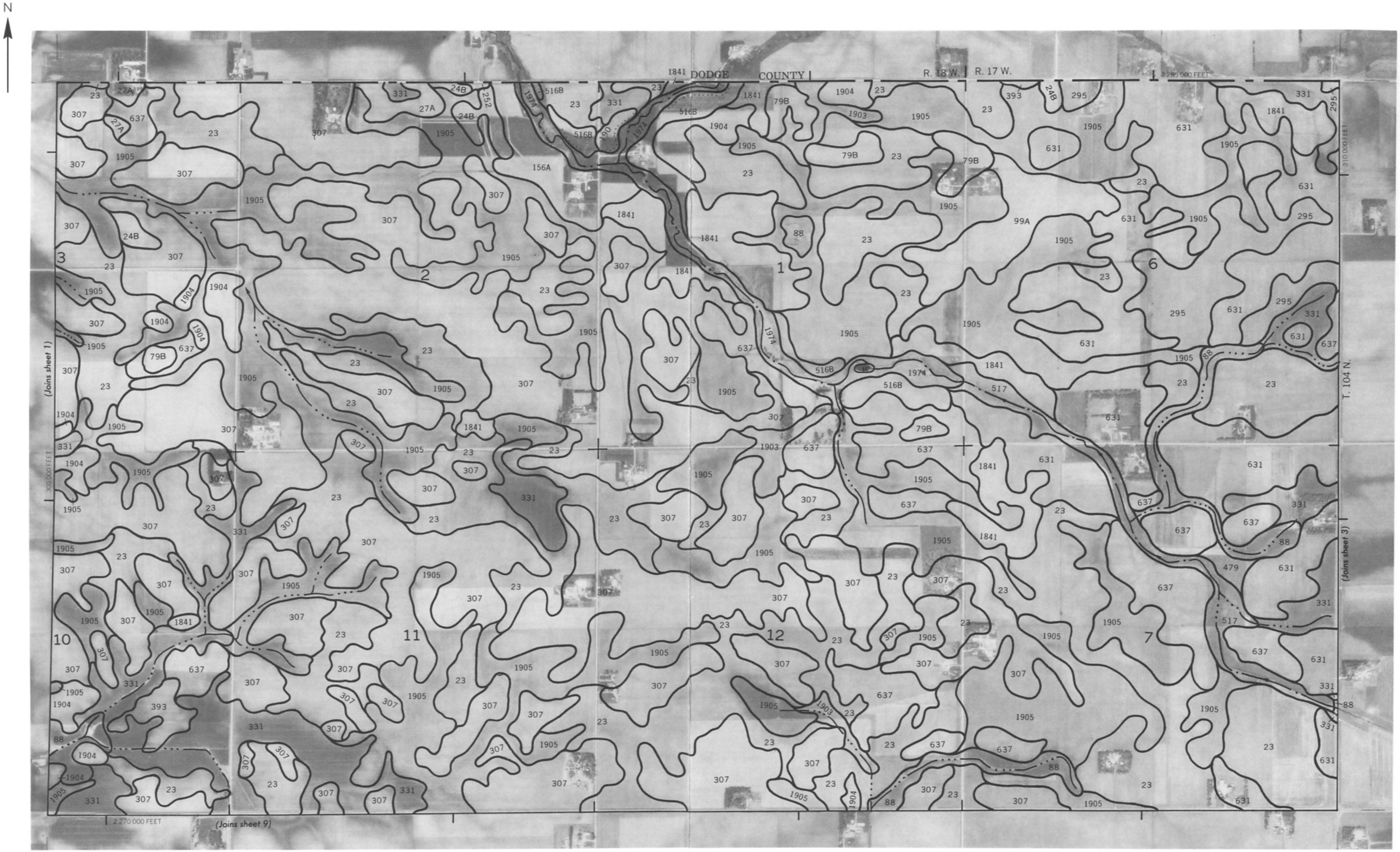
N

MOWER COUNTY, MINNESOTA — SHEET NUMBER 2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(Joins sheet 9)
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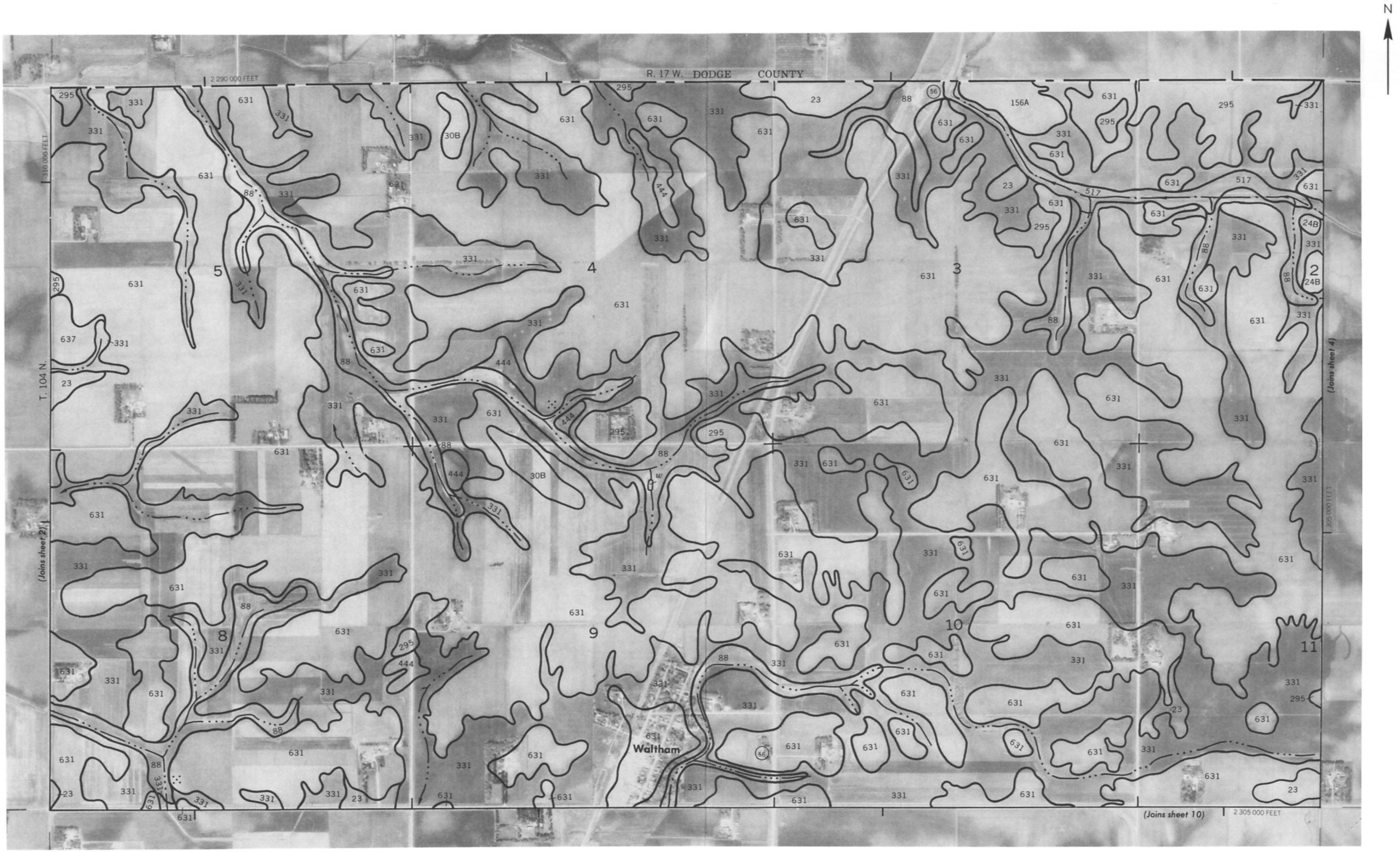
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(Joins sheet 4)
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(Joins sheet 10)
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Waltham
56
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4
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24B
30B
88
156A
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331
444
517
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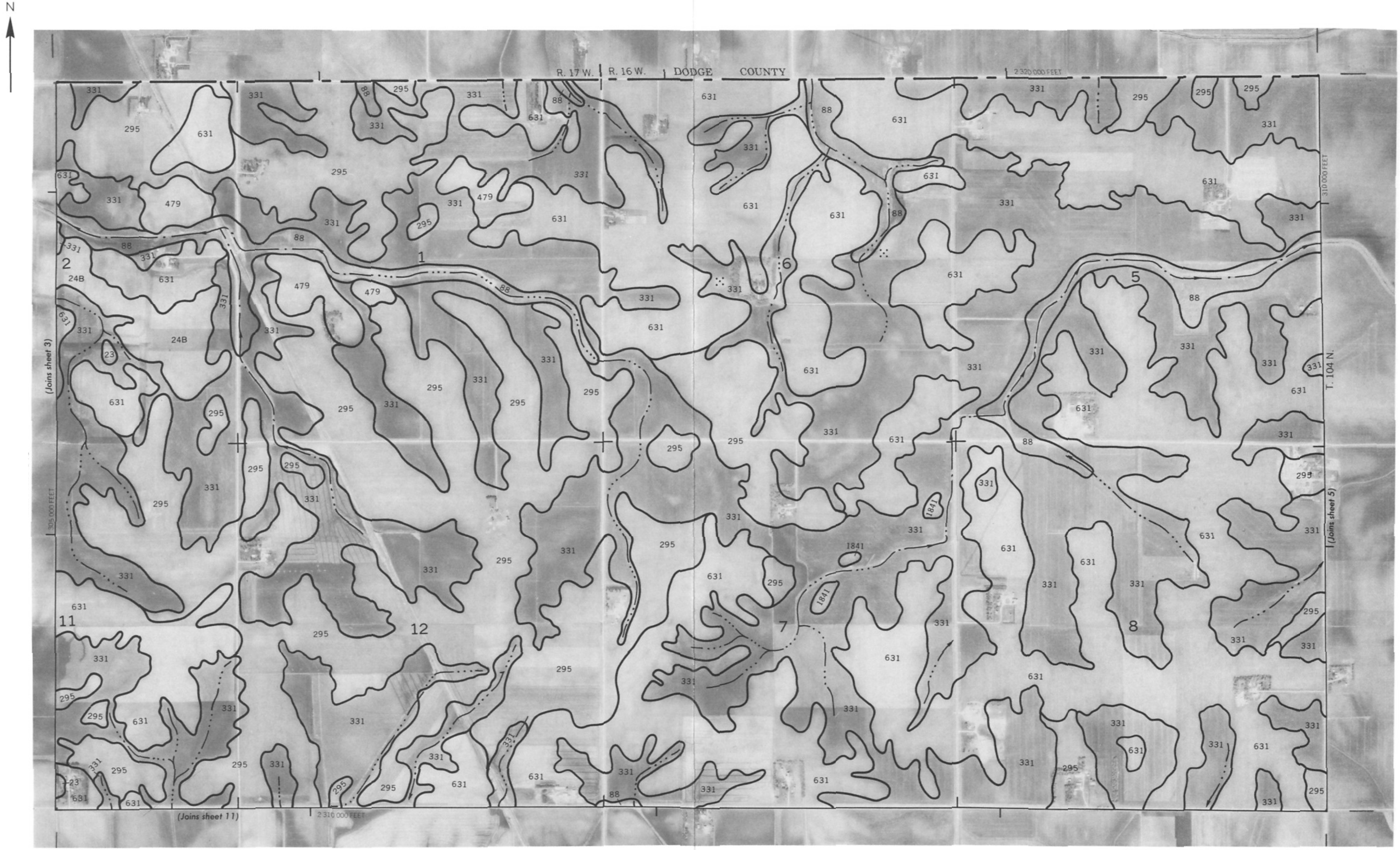
637

MOWER COUNTY, MINNESOTA — SHEET NUMBER 4

④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DODGE COUNTY
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T. 104 N.
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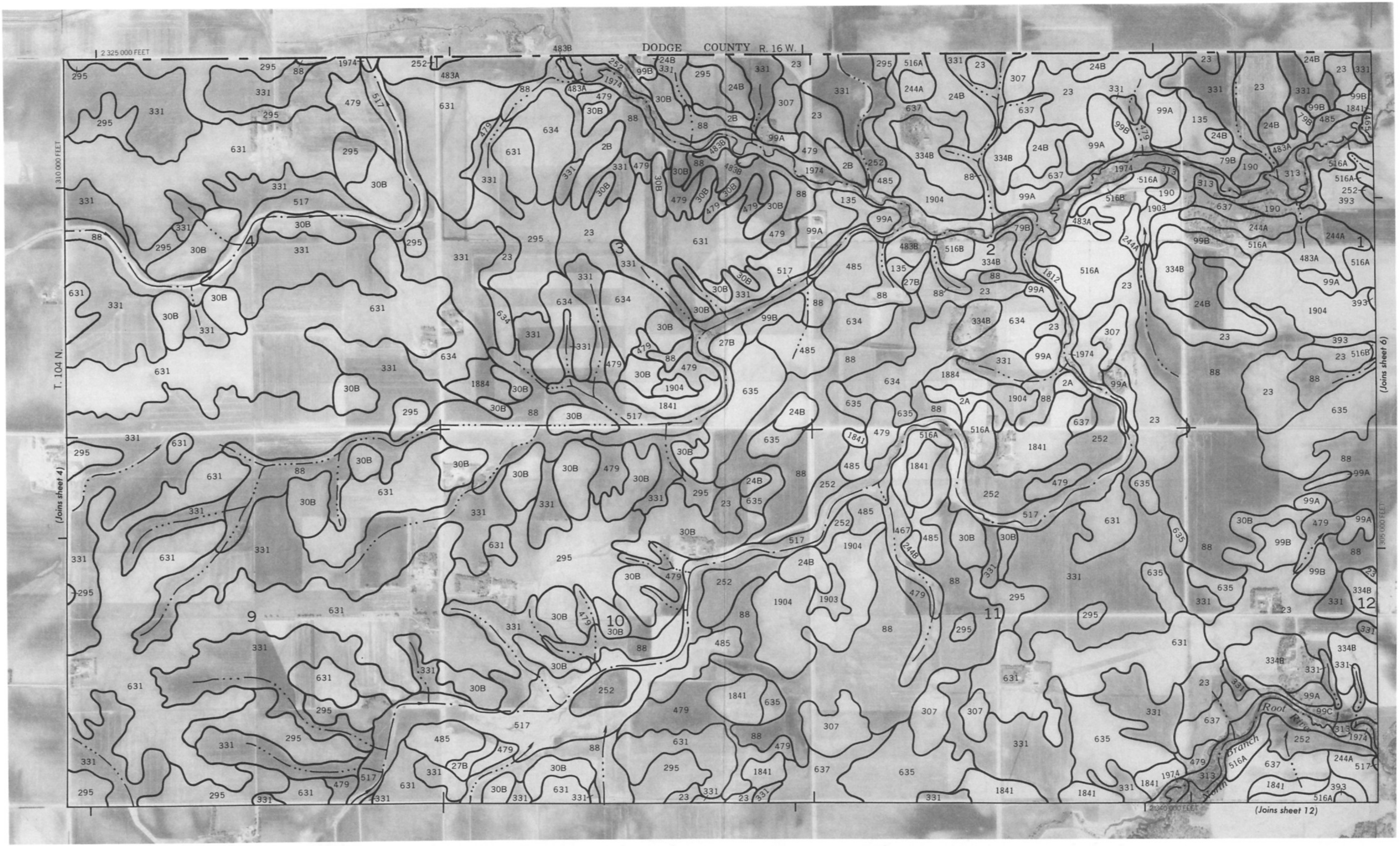
MOWER COUNTY, MINNESOTA — SHEET NUMBER 5


N
DODGE COUNTY
R. 16 W.
2 325 000 FEET
310 000 FEET
T. 104 N.
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(Joins sheet 6)
305 000 FEET
2 340 000 FEET
(Joins sheet 12)
North Branch
Root River
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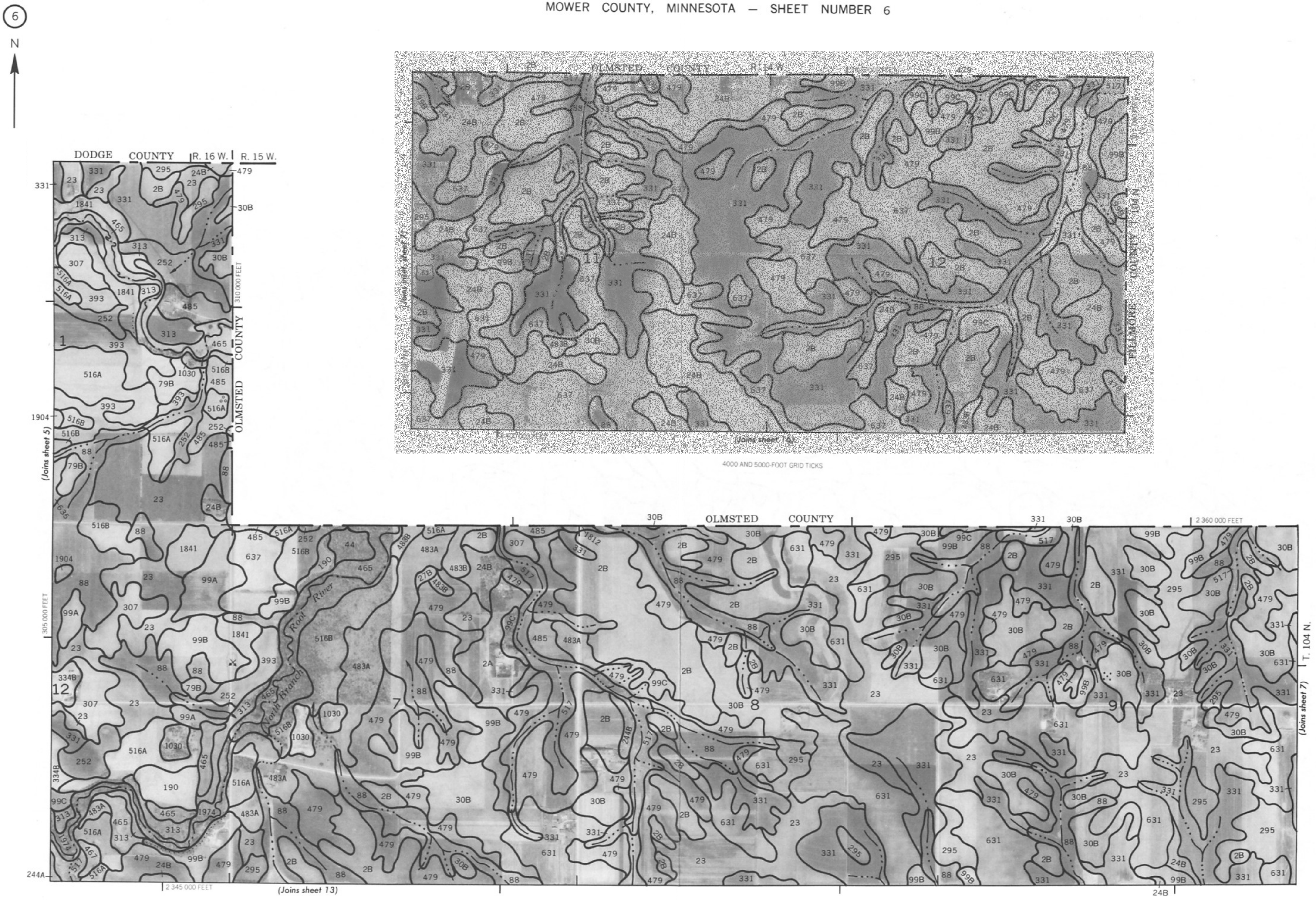
MOWER COUNTY, MINNESOTA — SHEET NUMBER 6



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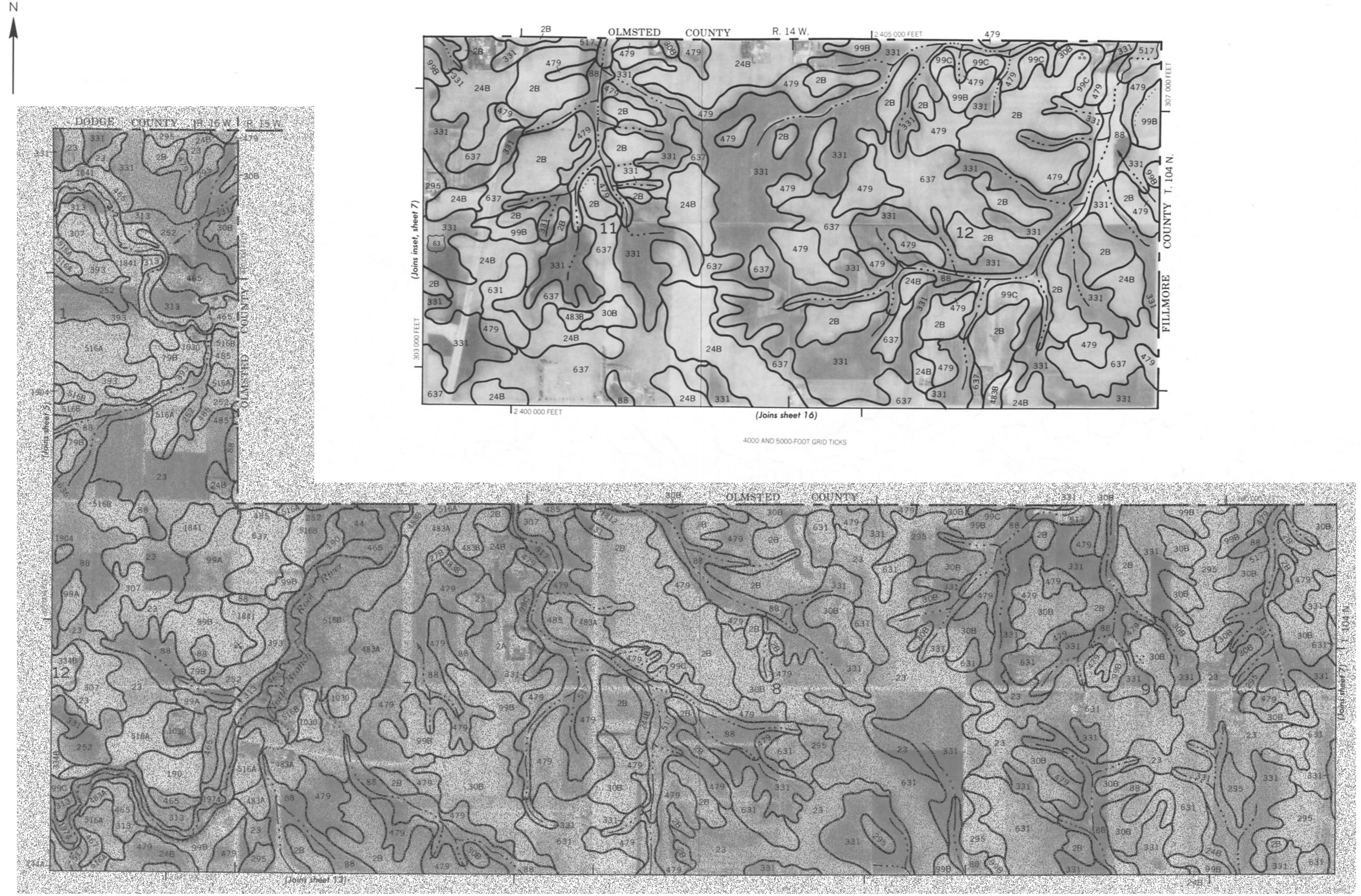
N
DODGE COUNTY
R. 16 W.
R. 15 W.
OLMSTED COUNTY
R. 14 W.
FILLMORE COUNTY
T. 104 N.
(Joins sheet 5)
(Joins sheet 7)
(Joins sheet 13)
(Joins sheet 16)
310 000 FEET
305 000 FEET
2 345 000 FEET
2 360 000 FEET
4000 AND 5000-FOOT GRID TICKS
Root River
North Branch
1
7
8
9
11
12

⑥

MOWER COUNTY, MINNESOTA — SHEET NUMBER 6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FILLMORE COUNTY
(Joins inset, sheet 7)
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2 400 000 FEET
(Joins sheet 16)
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DODGE COUNTY
R. 16 W.
R. 15 W.
OLMSTED COUNTY
(Joins sheet 5)
Root River
1
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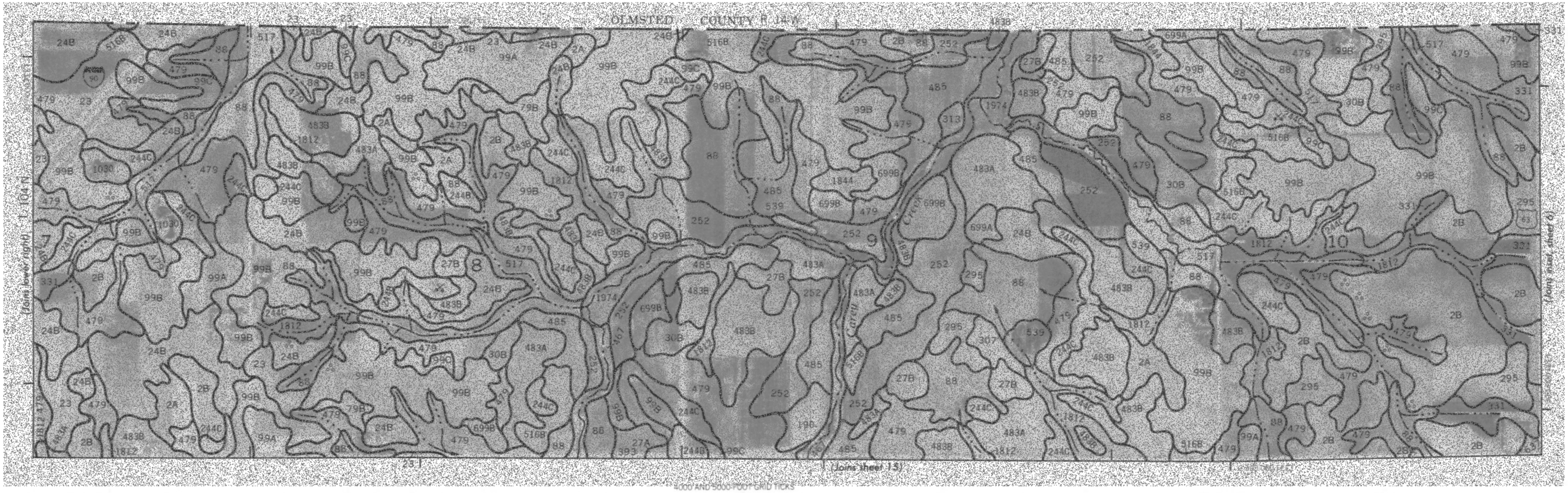
(Joins sheet 13)
(Joins sheet 7)
T. 104 N.

4000 AND 5000-FOOT GRID TICKS

MOWER COUNTY, MINNESOTA — SHEET NUMBER 7

N



OLMSTED COUNTY R. 14 W.
T. 104 N.
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(Joins sheet 13)
4000 AND 5000 FOOT GRID TICKS
Creek
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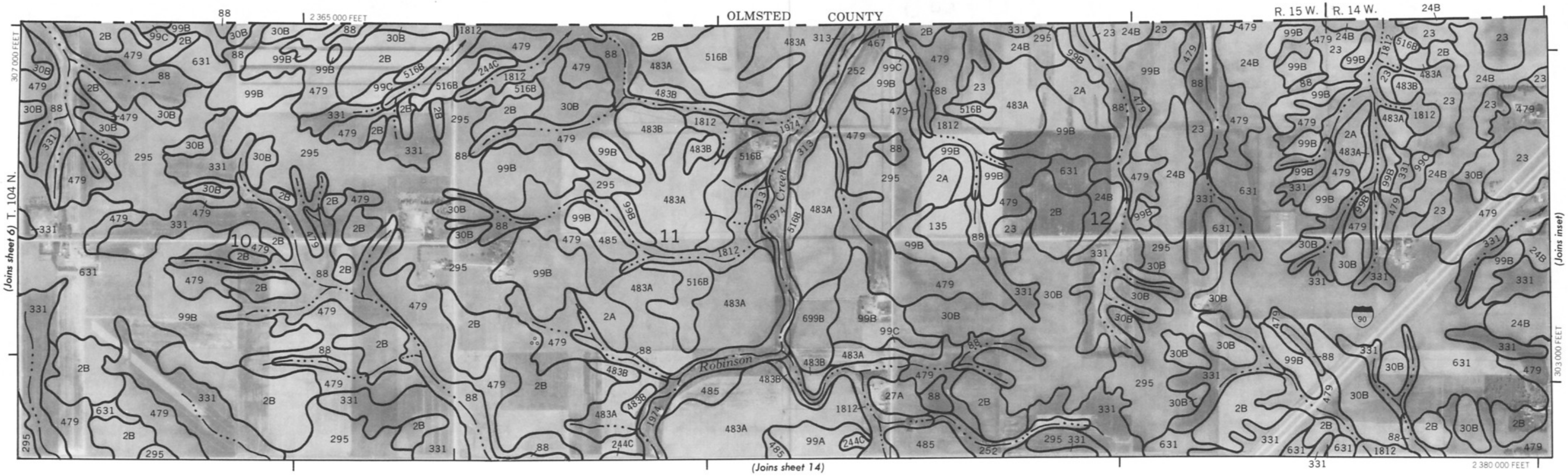

OLMSTED COUNTY
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R. 14 W.
2 365 000 FEET
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(Joins inset)
303 000 FEET
(Joins sheet 14)
2 380 000 FEET
Robinson
Creek
90
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11
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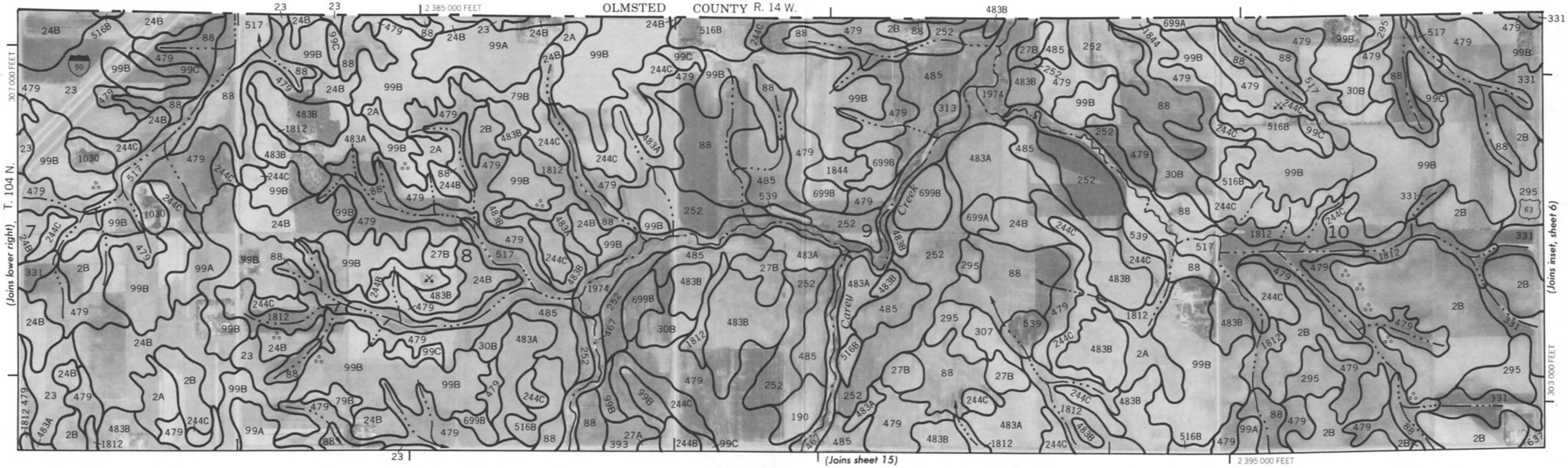
MOWER COUNTY, MINNESOTA — SHEET NUMBER 7


N
OLMSTED COUNTY
R. 14 W.
2 385 000 FEET
2 395 000 FEET
307 000 FEET
303 000 FEET
T. 104 N.
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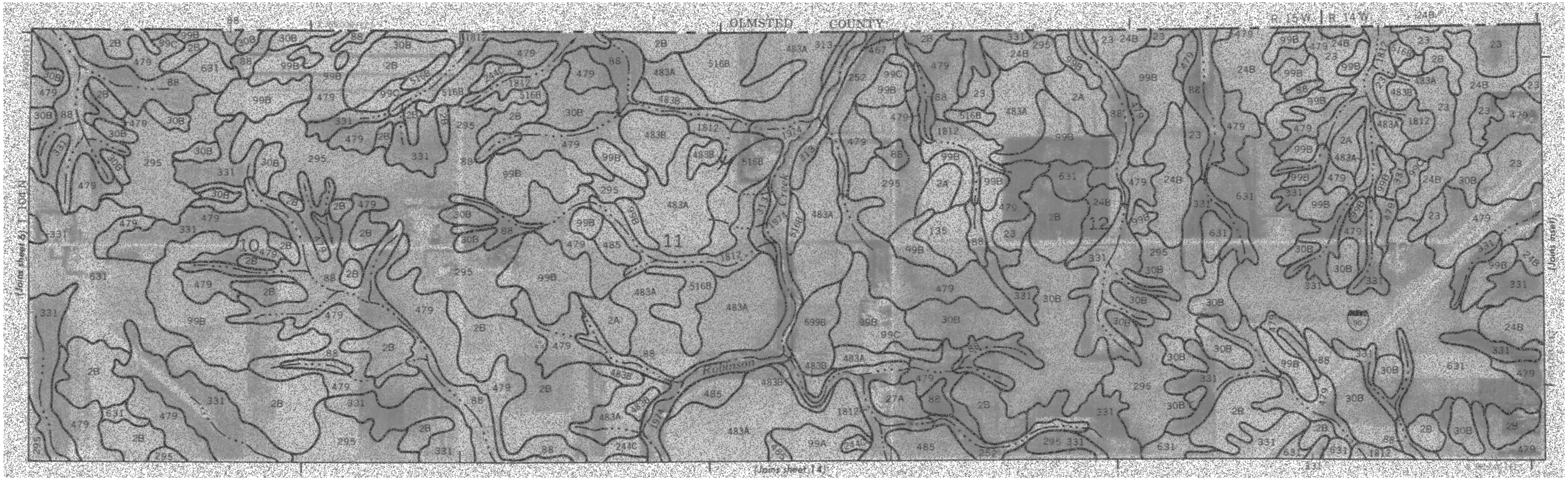
(Joins sheet 15)
Carey Creek
90
63

4000 AND 5000-FOOT GRID TICKS


OLMSTED COUNTY
R. 15 W.
R. 14 W.
T. 104 N.
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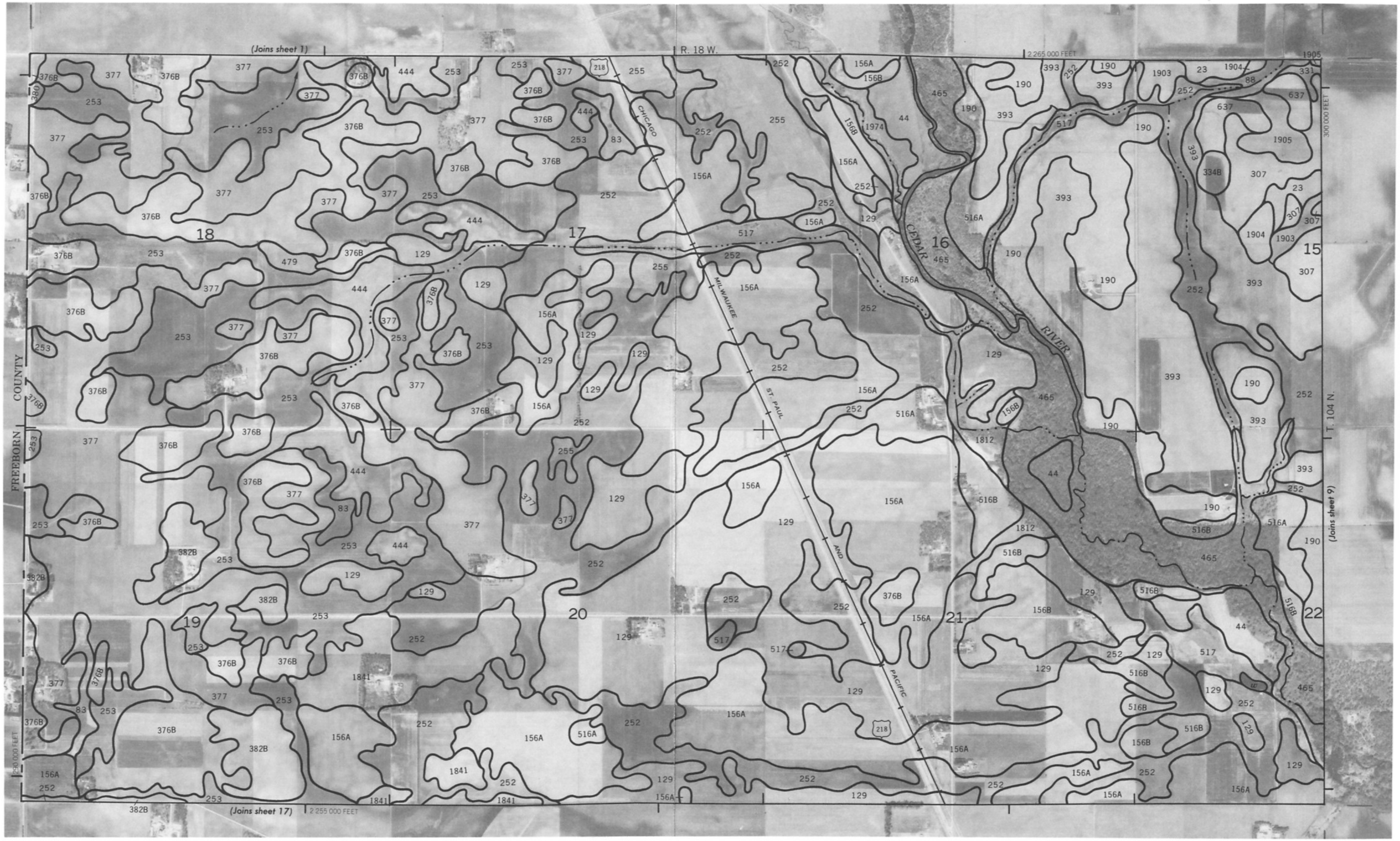
(Joins sheet 14)
Robinson
Creek
90

⑧

N

MOWER COUNTY, MINNESOTA — SHEET NUMBER 8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FREEBORN COUNTY
CHICAGO MILWAUKEE ST. PAUL AND PACIFIC
CEDAR RIVER
218
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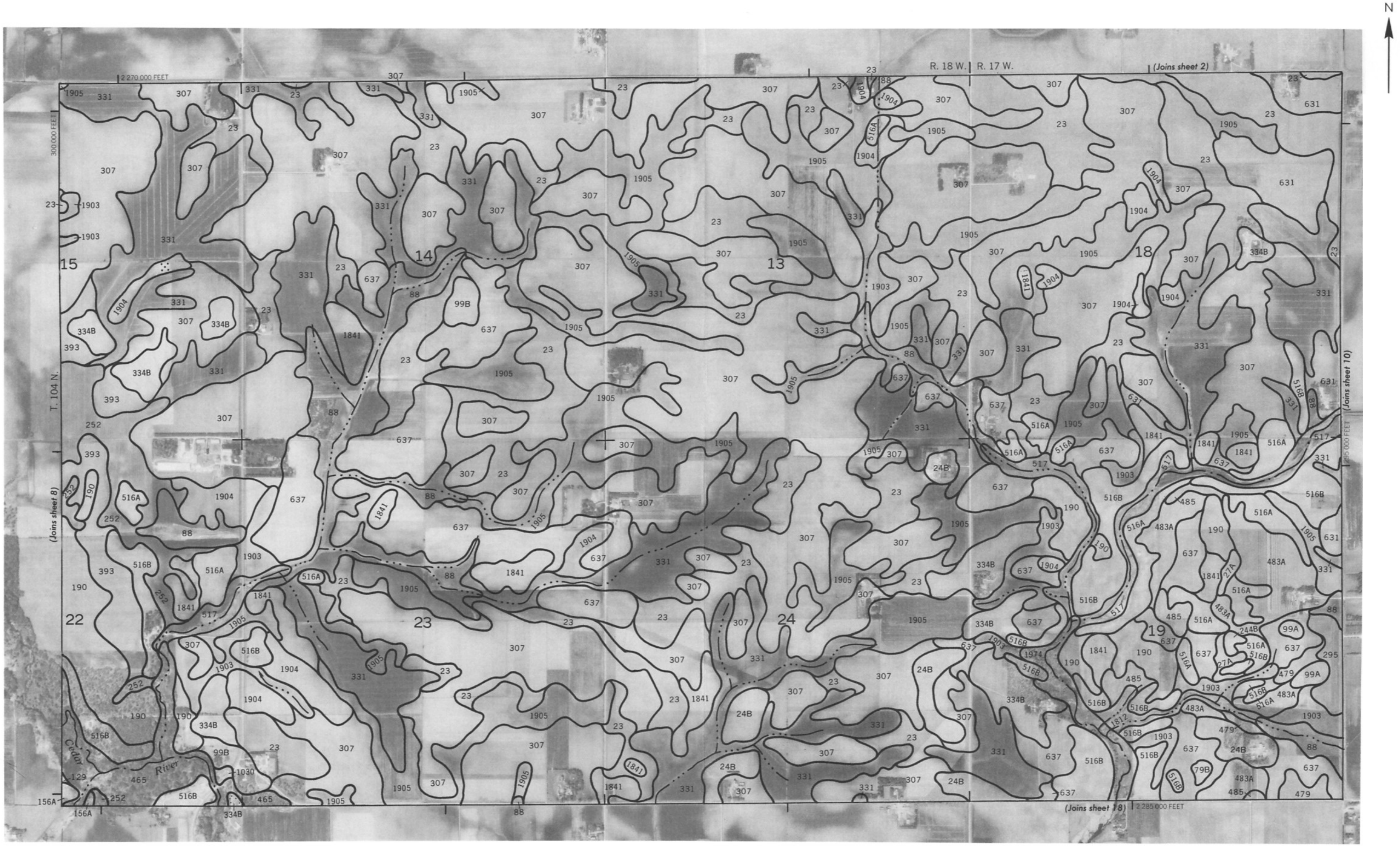
MOWER COUNTY, MINNESOTA — SHEET NUMBER 9

⑨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T. 104 N.
(Joins sheet 2)
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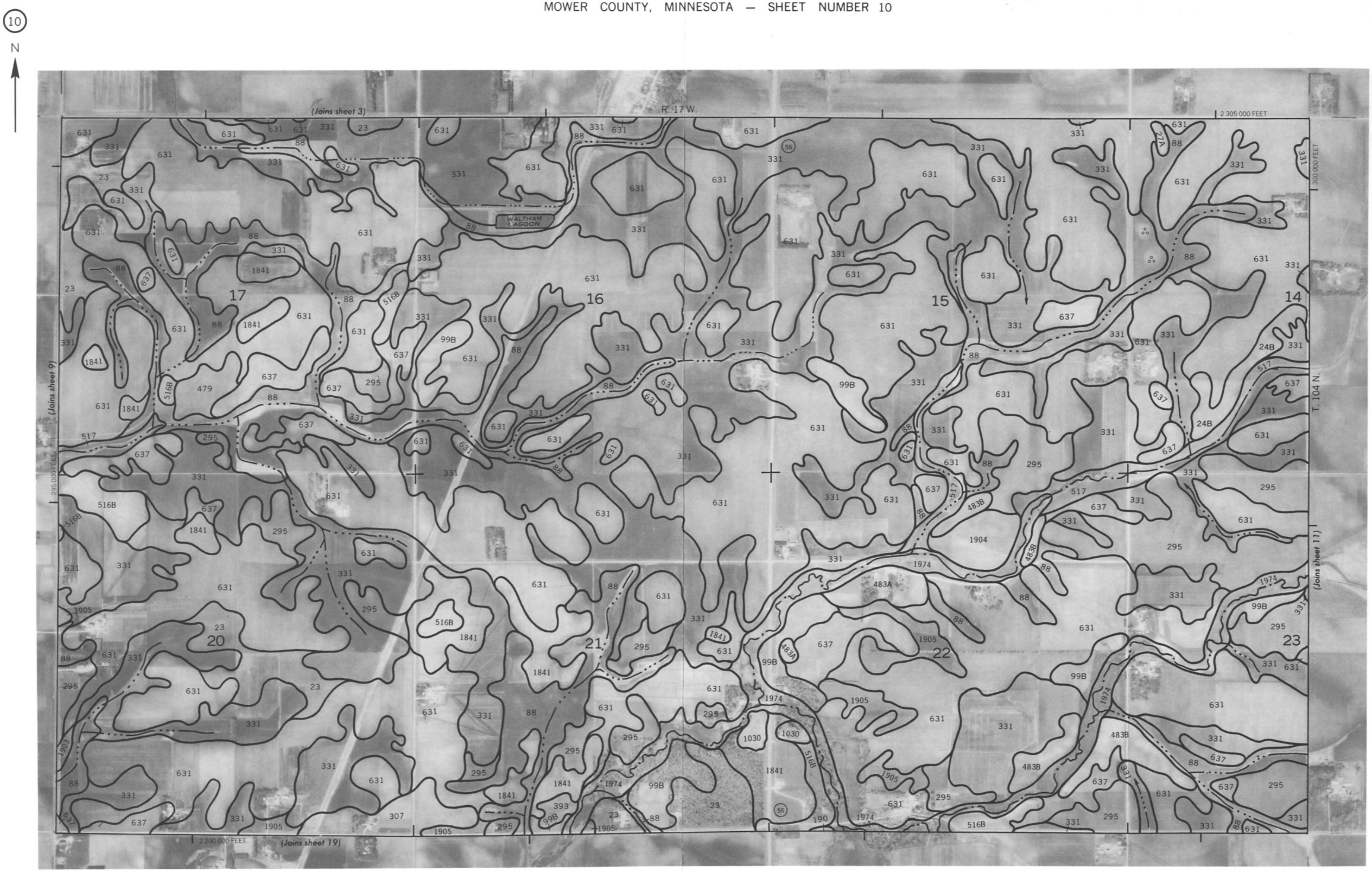
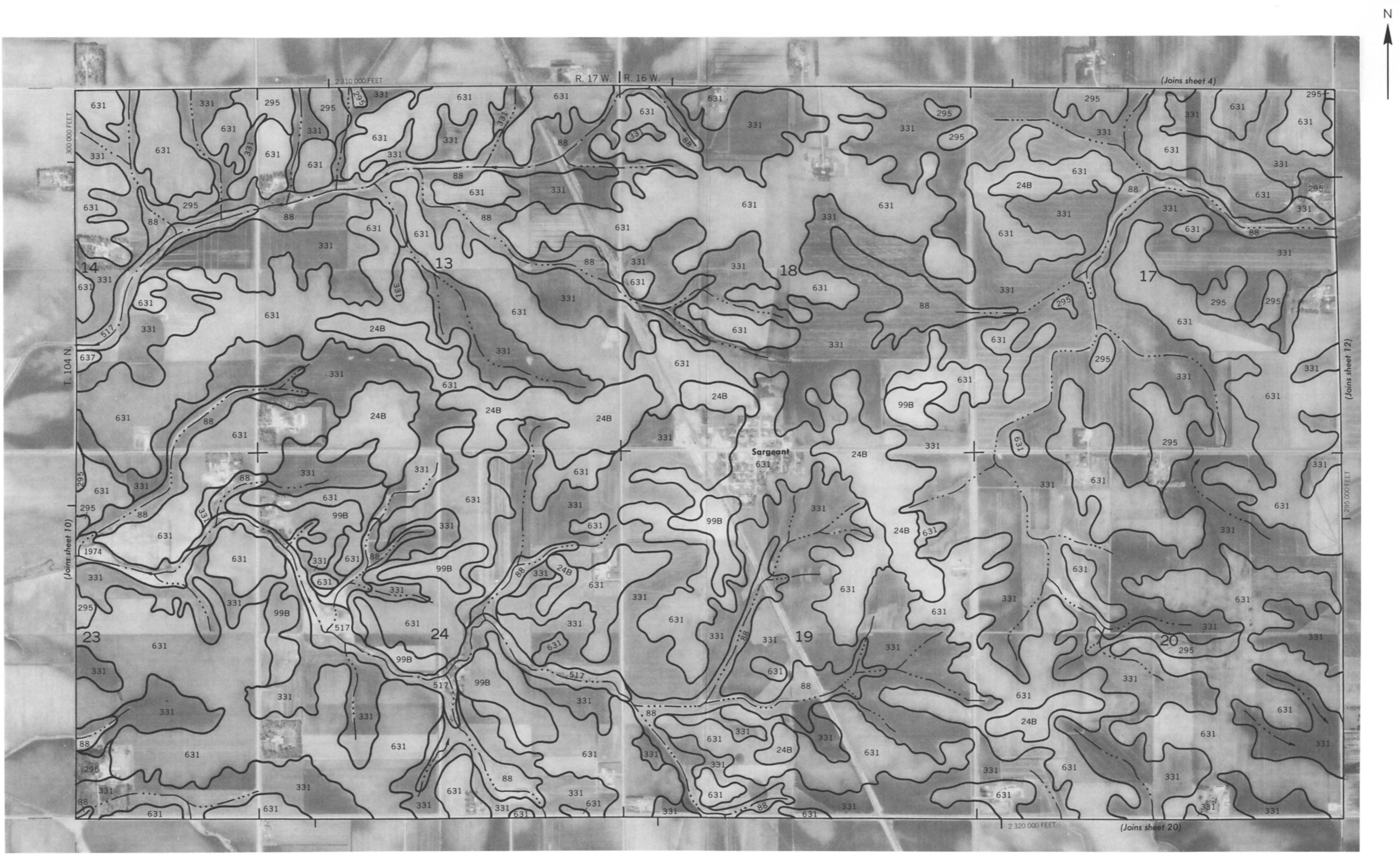
24
19
Cedar
River


10
N
(Joins sheet 3)
R. 17 W.
2 305 000 FEET
300 000 FEET
(Joins sheet 9)
295 000 FEET
T. 104 N.
(Joins sheet 11)
2 290 000 FEET
(Joins sheet 19)
WALTHAM LAGOON
17
16
15
14
20
21
22
23

MOWER COUNTY, MINNESOTA — SHEET NUMBER 11

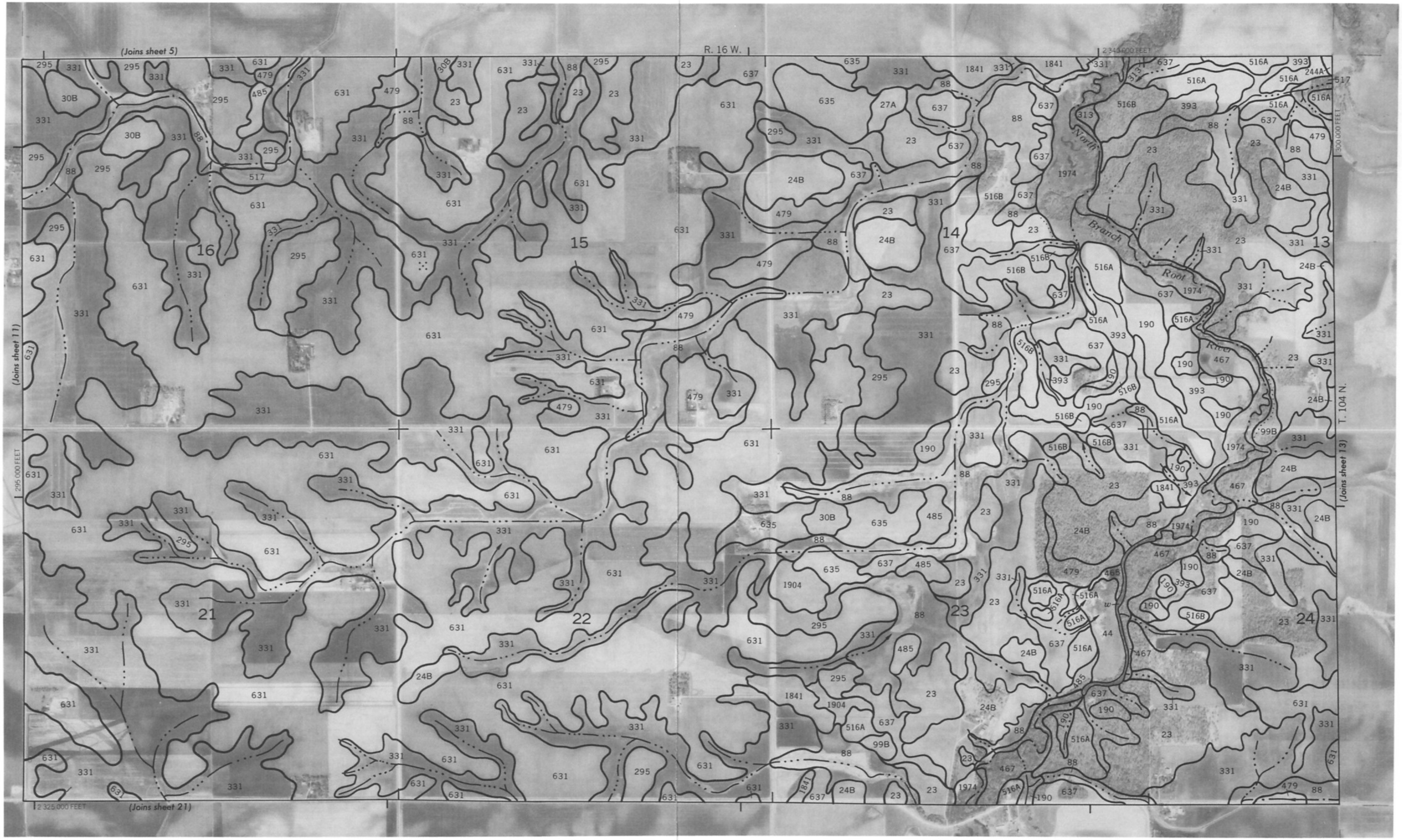
⑪


N
R. 17 W.
R. 16 W.
2 310 000 FEET
(Joins sheet 4)
300 000 FEET
T. 104 N.
(Joins sheet 10)
(Joins sheet 12)
295 000 FEET
2 320 000 FEET
(Joins sheet 20)
13
14
17
18
19
20
23
24
Sargeant
24B
88
99B
295
331
517
631
637
1974

⑫

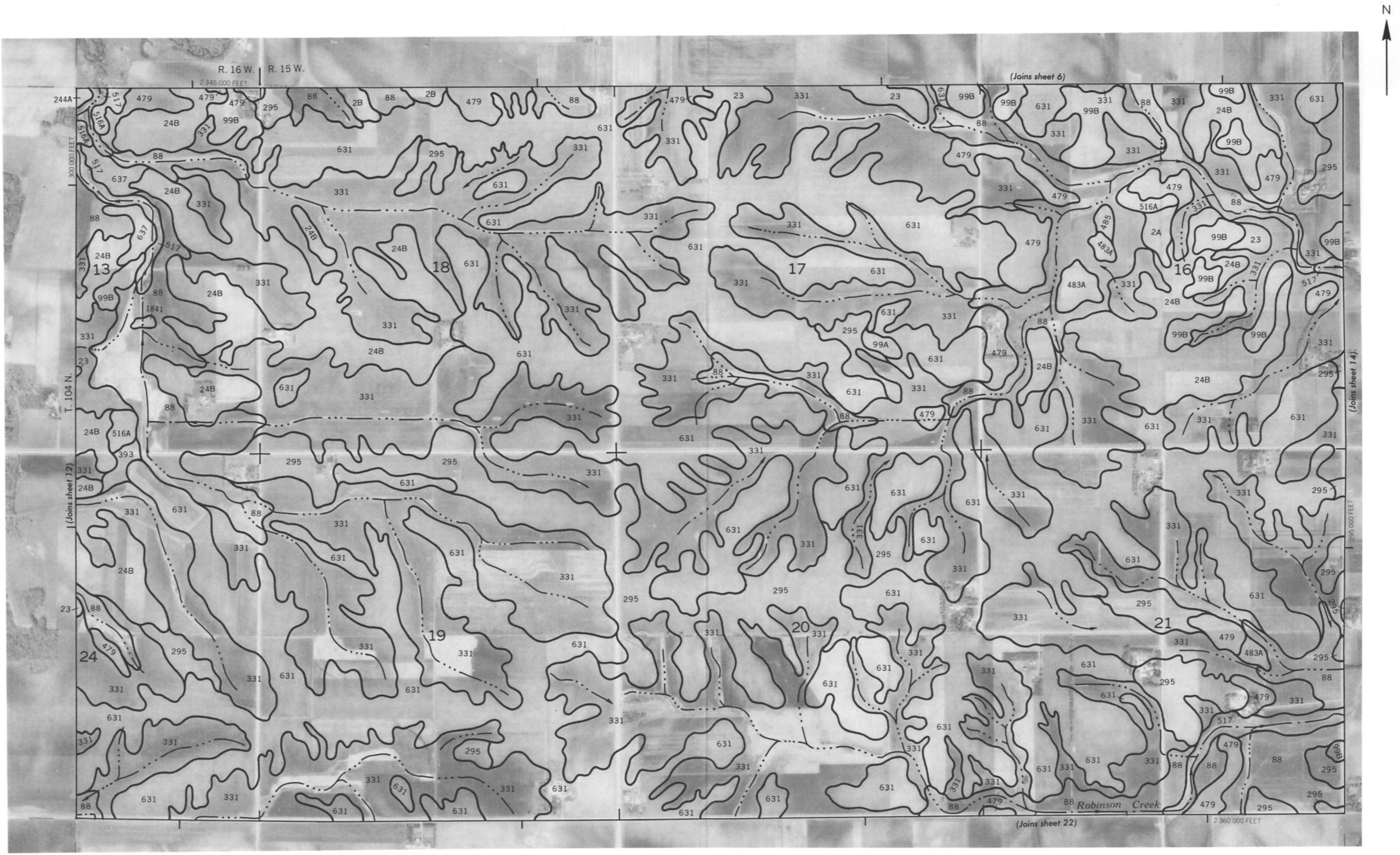
N

MOWER COUNTY, MINNESOTA — SHEET NUMBER 12

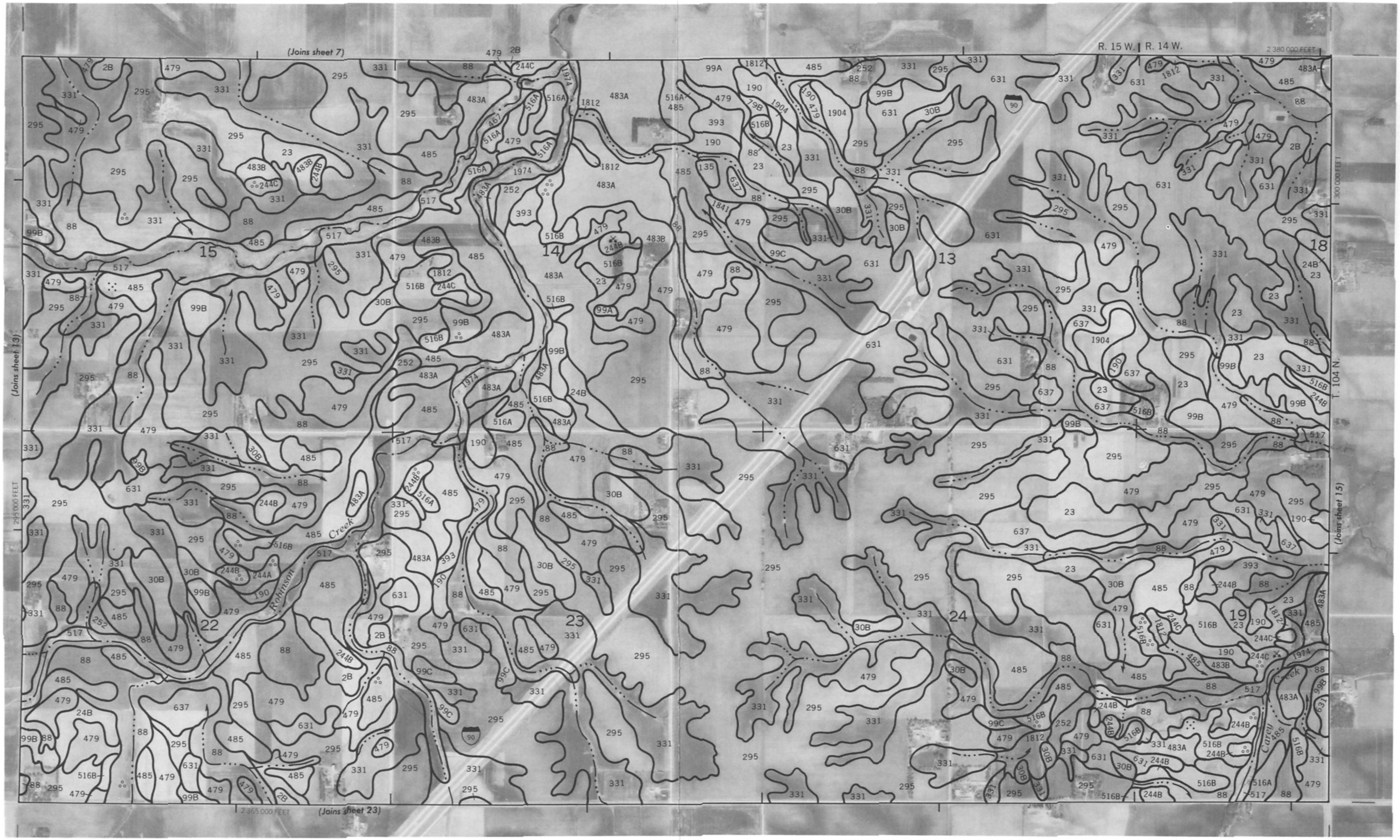

(Joins sheet 5)
R. 16 W.
2 340 000 FEET
300 000 FEET
T. 104 N.
(Joins sheet 13)
(Joins sheet 21)
2 325 000 FEET
(Joins sheet 11)
295 000 FEET
North Branch Root River
13
14
15
16
21
22
23
24

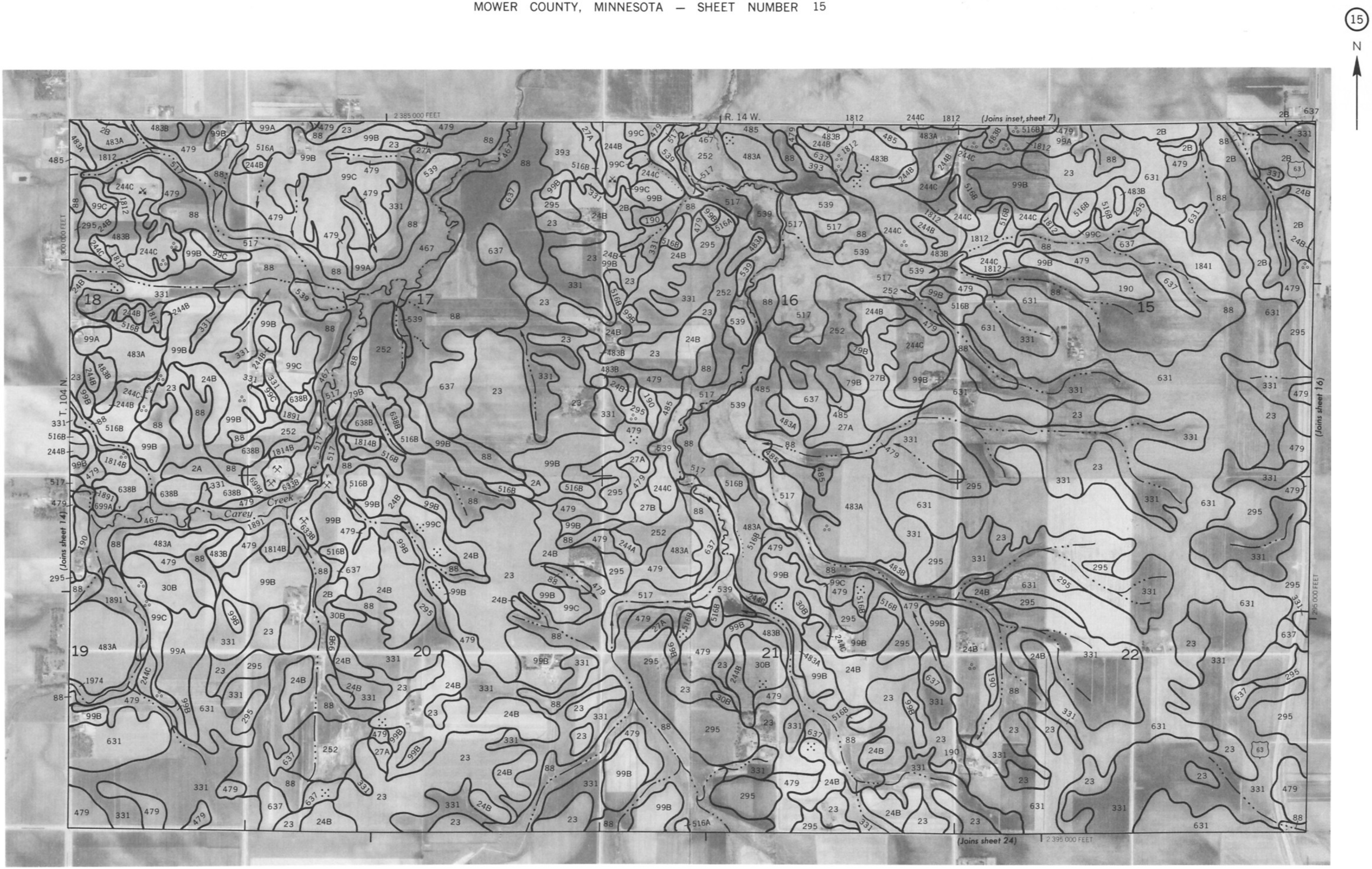
MOWER COUNTY, MINNESOTA — SHEET NUMBER 13

⑬

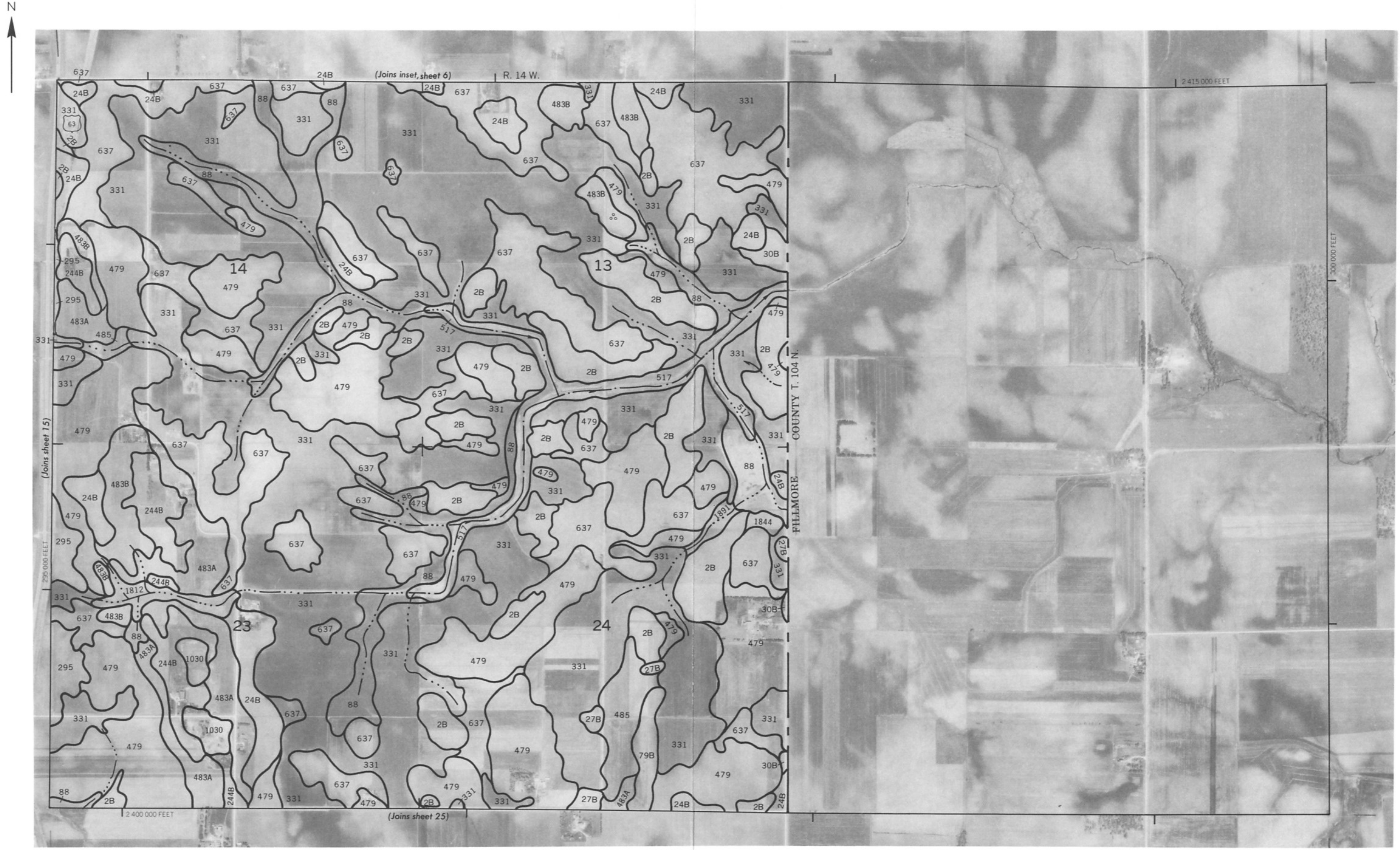

N
R. 16 W.
R. 15 W.
2 345 000 FEET
(Joins sheet 6)
300 000 FEET
T. 104 N.
(Joins sheet 12)
(Joins sheet 14)
295 000 FEET
(Joins sheet 22)
2 360 000 FEET
13
18
17
16
24
19
20
21
Robinson Creek
244A
516A
517
637
1841
393
483A
485
99A
99B
24B
2A
2B
23
88
295
331
479
631

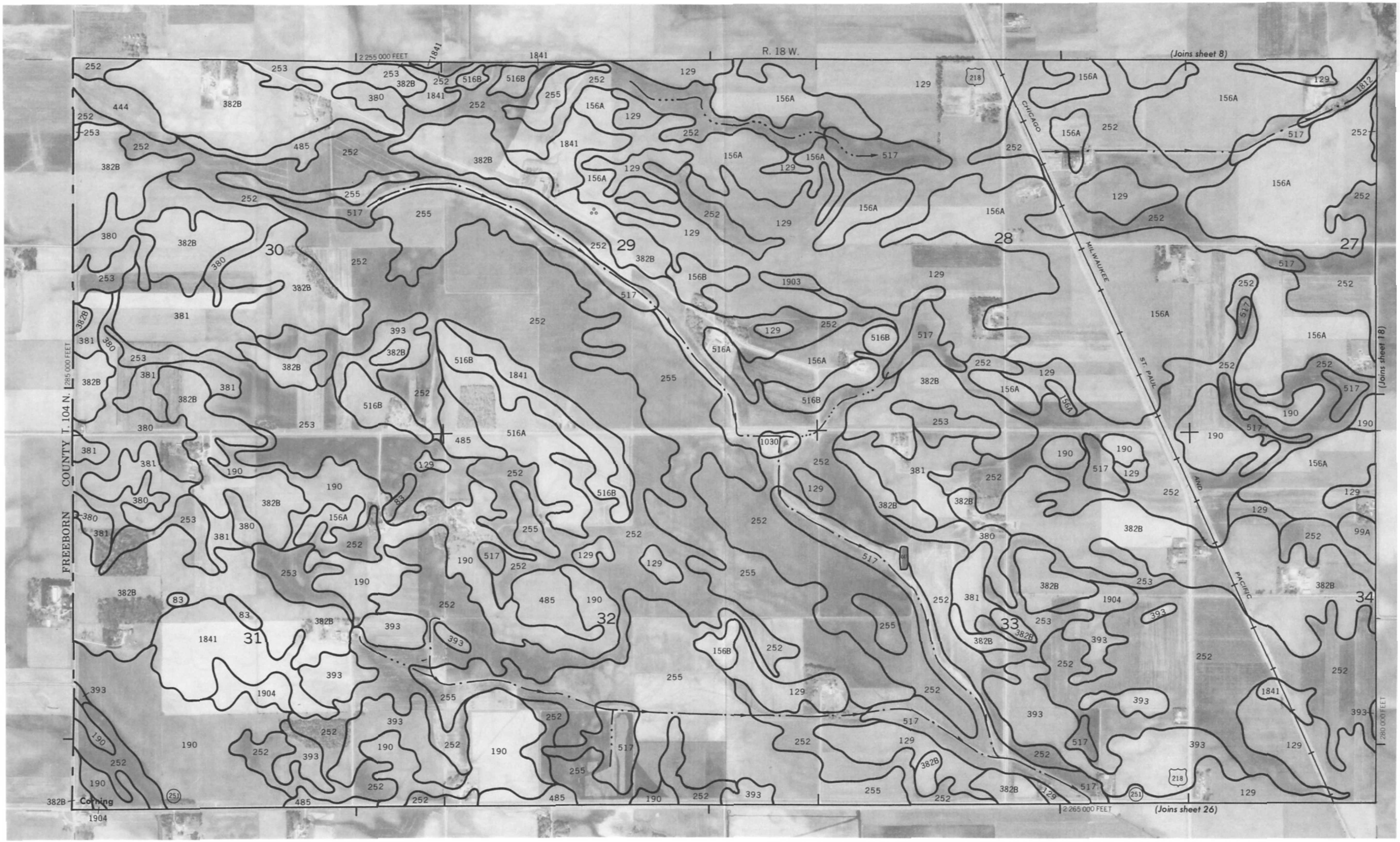
N


(Joins sheet 7)
(Joins sheet 13)
(Joins sheet 15)
(Joins sheet 23)
R. 15 W.
R. 14 W.
T. 104 N.
2 380 000 FEET
300 000 FEET
295 000 FEET
2 365 000 FEET
90
Robinson Creek
Carey Creek
15
14
13
18
22
23
24
19

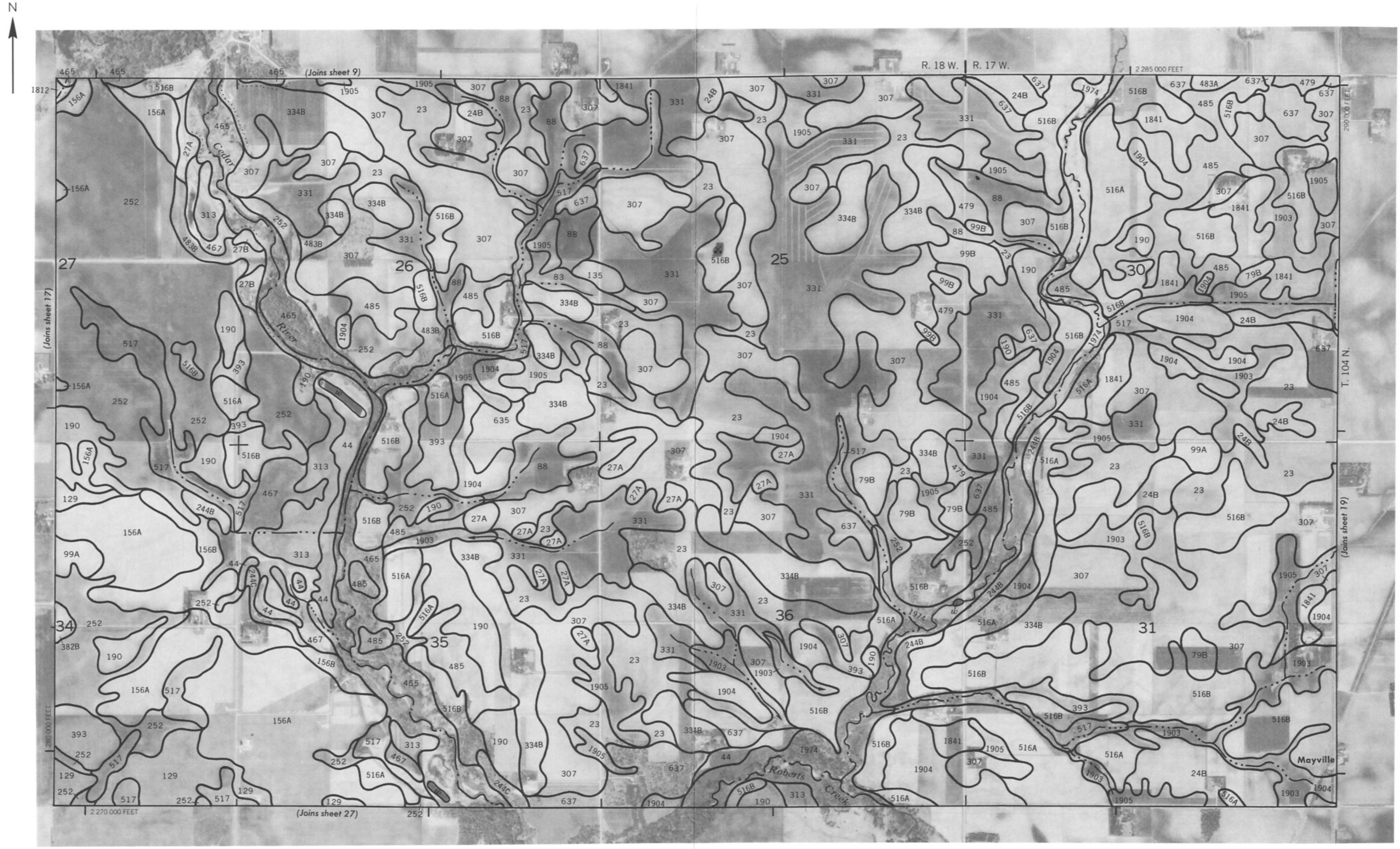

15
N
2 385 000 FEET
R. 14 W.
(Joins inset, sheet 7)
T. 104 N.
300 000 FEET
(Joins sheet 14)
(Joins sheet 16)
295 000 FEET
(Joins sheet 24)
2 395 000 FEET
Carey Creek
18
17
16
15
19
20
21
22
63

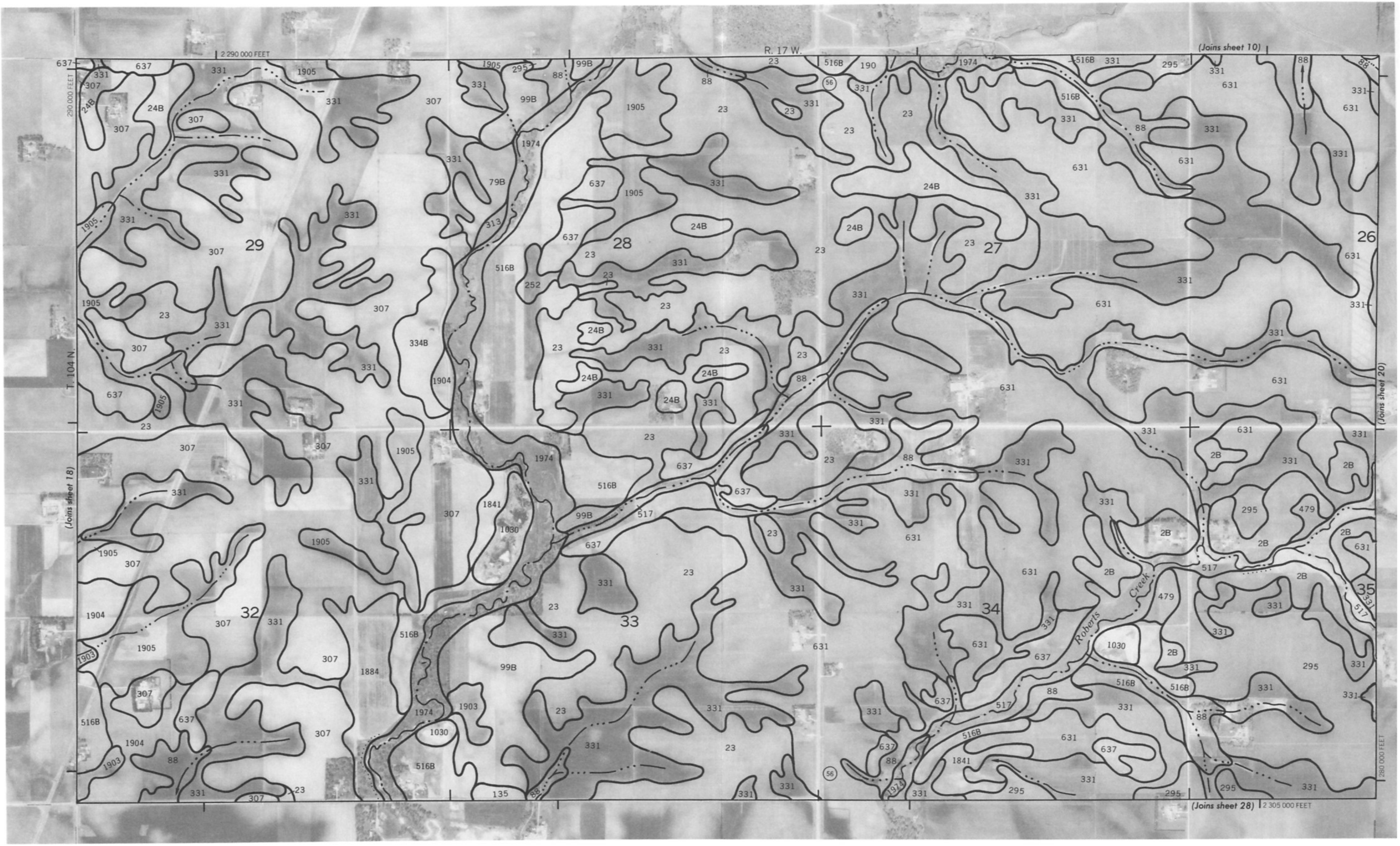
MOWER COUNTY, MINNESOTA — SHEET NUMBER 16

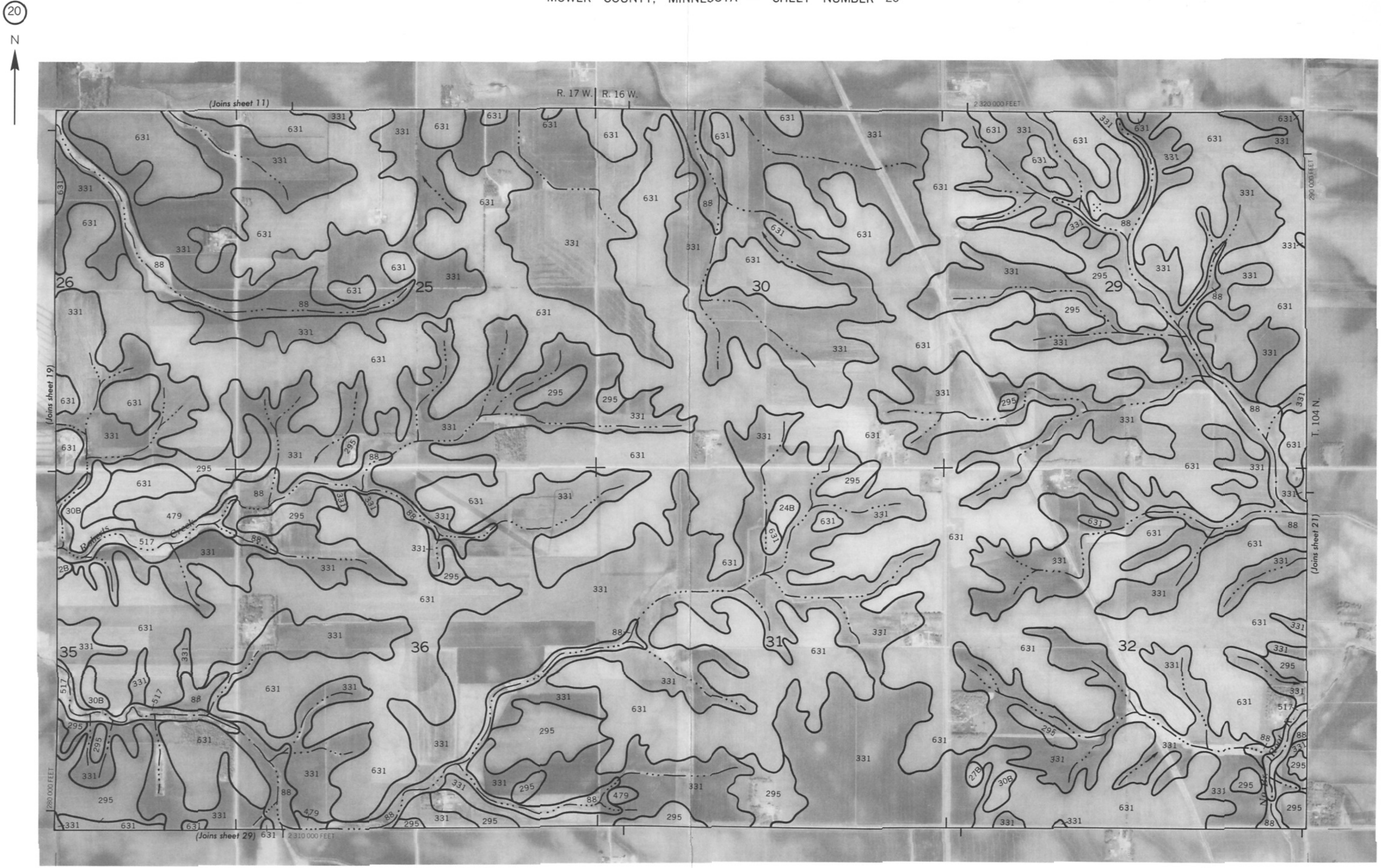

N
(Joins inset, sheet 6)
R. 14 W.
2 415 000 FEET
300 000 FEET
(Joins sheet 15)
295 000 FEET
FILLMORE COUNTY T. 104 N.
2 400 000 FEET
(Joins sheet 25)
14
13
23
24
63
517
88
1891
1812
1844
1030
331
637
479
2B
24B
30B
27B
79B
244B
295
483A
483B
485


17
N
(Joins sheet 8)
(Joins sheet 18)
(Joins sheet 26)
R. 18 W.
FREEBORN COUNTY T. 104 N.
2 255 000 FEET
2 265 000 FEET
285 000 FEET
280 000 FEET
CHICAGO MILWAUKEE ST. PAUL AND PACIFIC
Corning
218
251
27
28
29
30
31
32
33
34

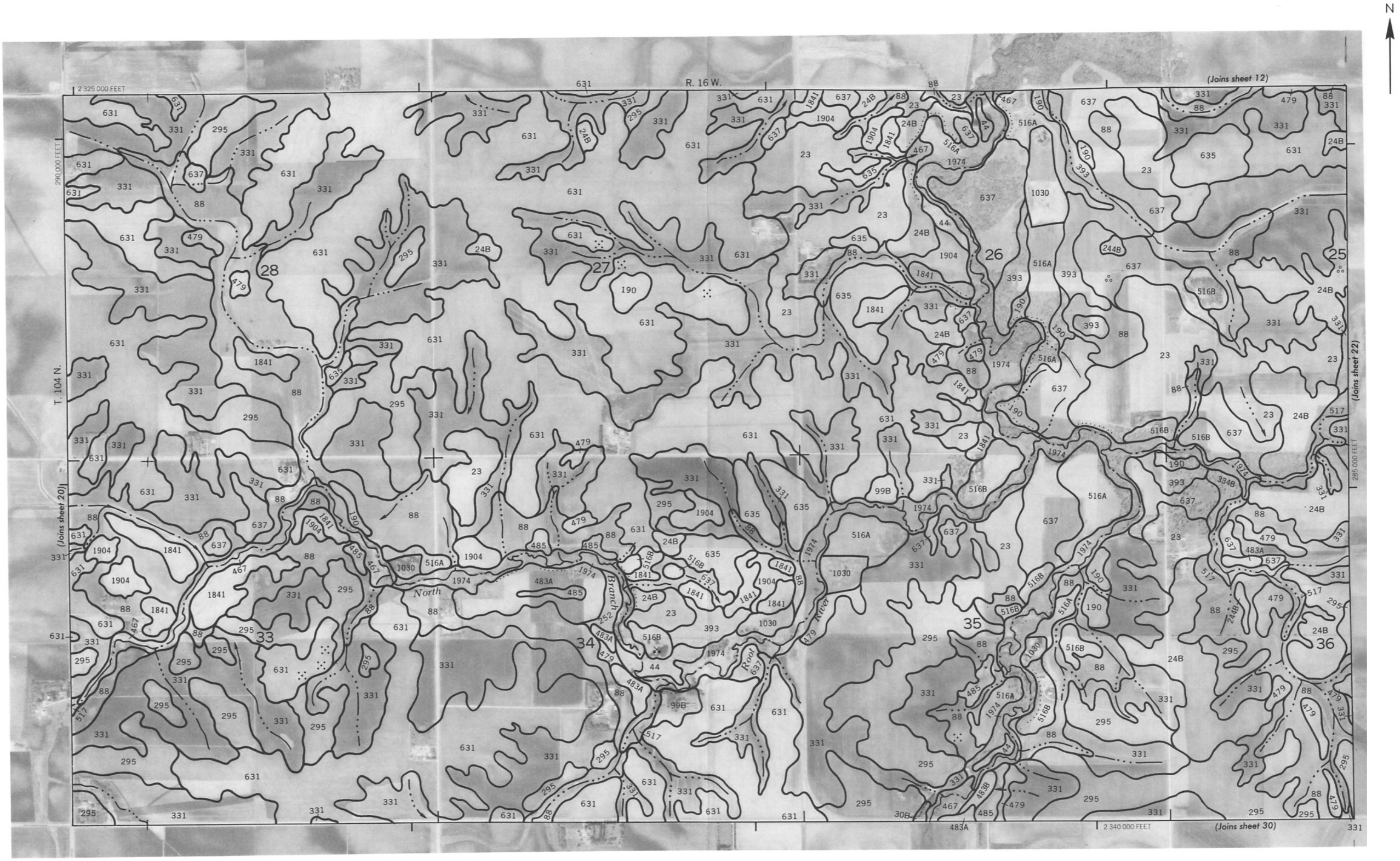
MOWER COUNTY, MINNESOTA — SHEET NUMBER 18


N
(Joins sheet 9)
R. 18 W.
R. 17 W.
2 285 000 FEET
290 000 FEET
T. 104 N.
(Joins sheet 17)
(Joins sheet 19)
(Joins sheet 27)
2 270 000 FEET
280 000 FEET
27
26
25
30
34
35
36
31
Cedar
River
Roberts
Creek
Mayville


N
R. 17 W.
T. 104 N.
2 290 000 FEET
290 000 FEET
280 000 FEET
2 305 000 FEET
(Joins sheet 10)
(Joins sheet 18)
(Joins sheet 20)
(Joins sheet 28)
26
27
28
29
32
33
34
35
Roberts Creek
56

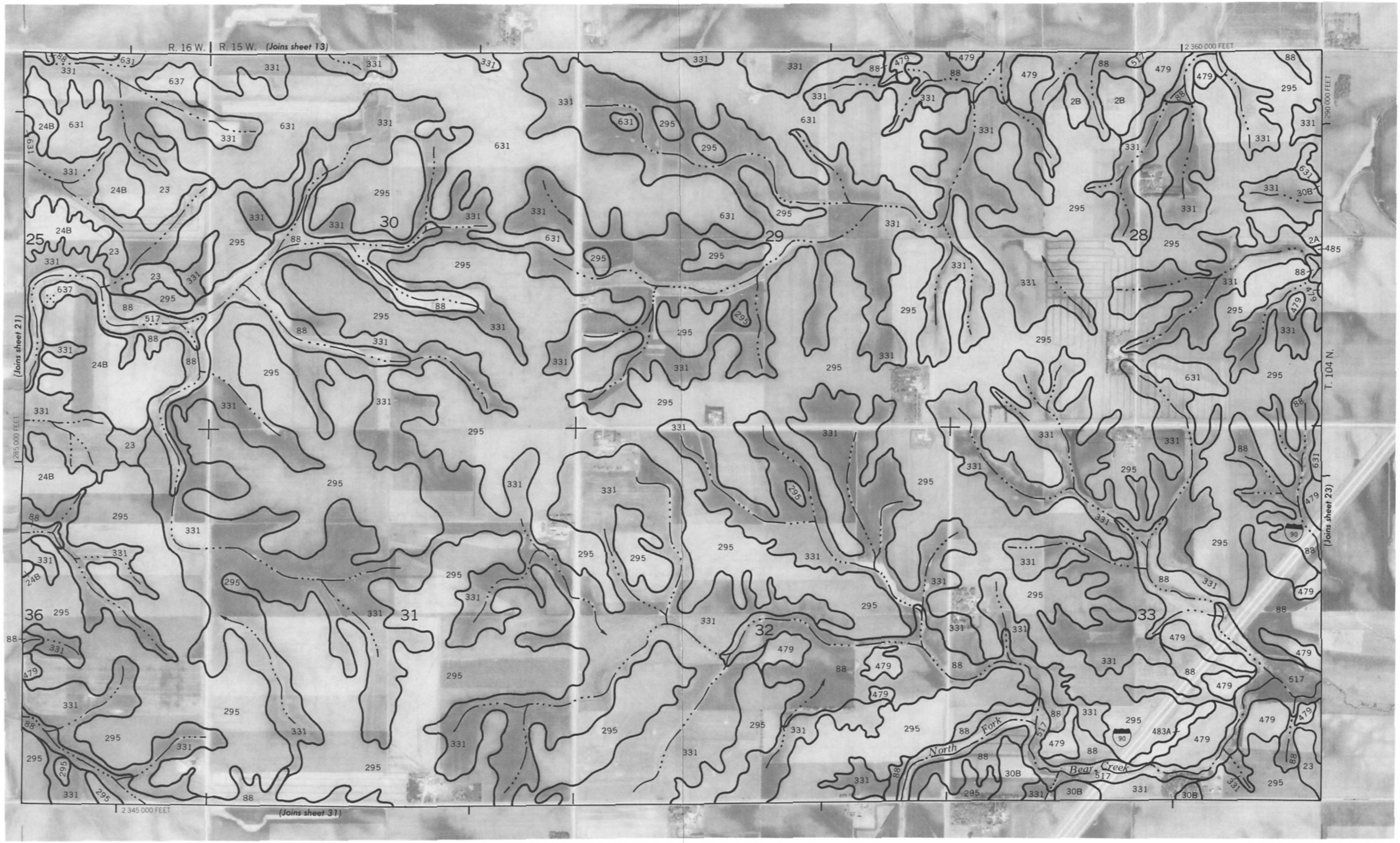


20
N
R. 17 W.
R. 16 W.
(Joins sheet 11)
(Joins sheet 19)
(Joins sheet 21)
(Joins sheet 29)
2 320 000 FEET
2 310 000 FEET
290 000 FEET
280 000 FEET
T. 104 N.
25
26
29
30
31
32
35
36
Roberts Creek

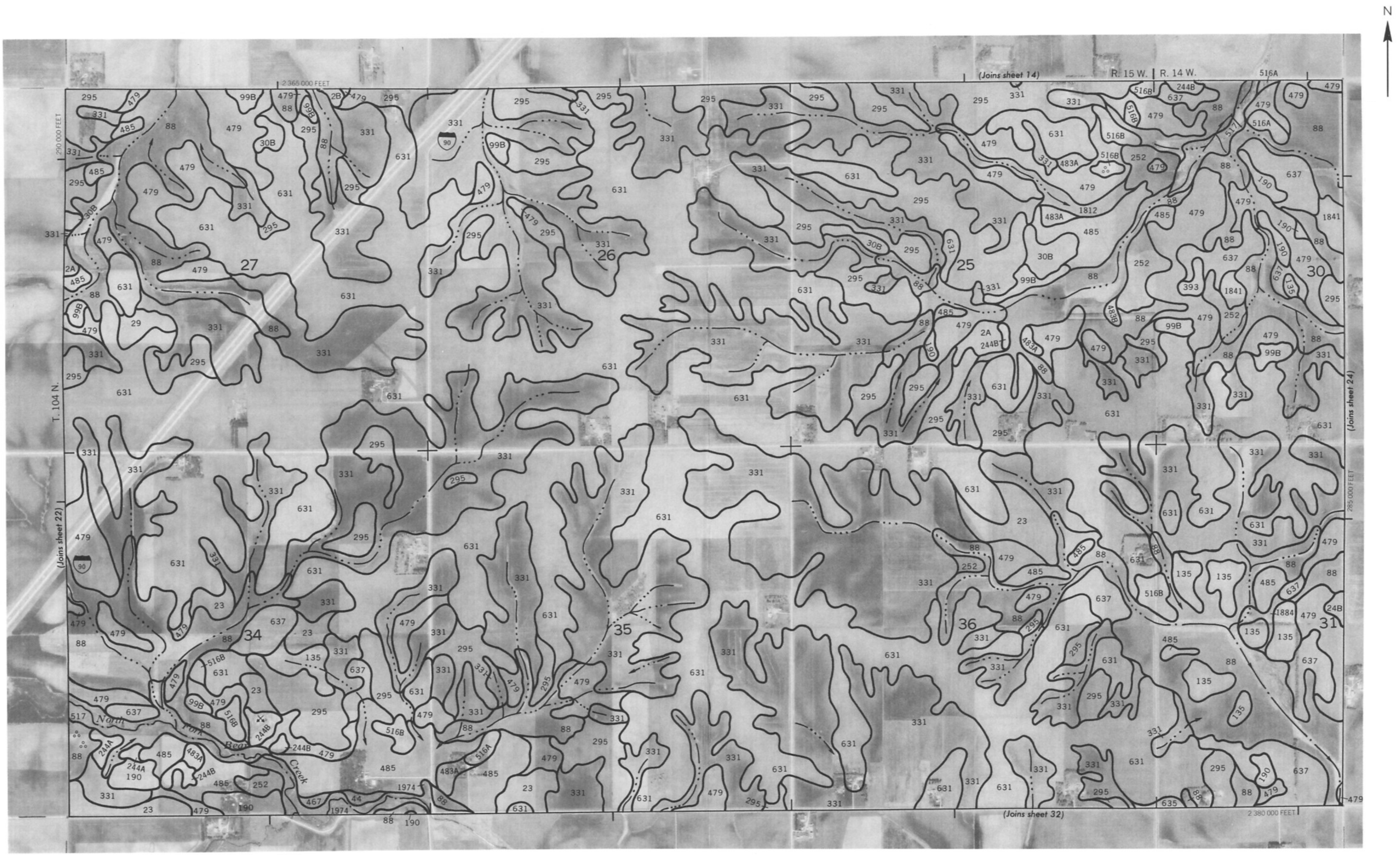

N
R. 16 W.
T. 104 N.
2 325 000 FEET
290 000 FEET
285 000 FEET
2 340 000 FEET
(Joins sheet 12)
(Joins sheet 22)
(Joins sheet 30)
(Joins sheet 20)
25
26
27
28
33
34
35
36
North
Branch
Root
River

MOWER COUNTY, MINNESOTA — SHEET NUMBER 22

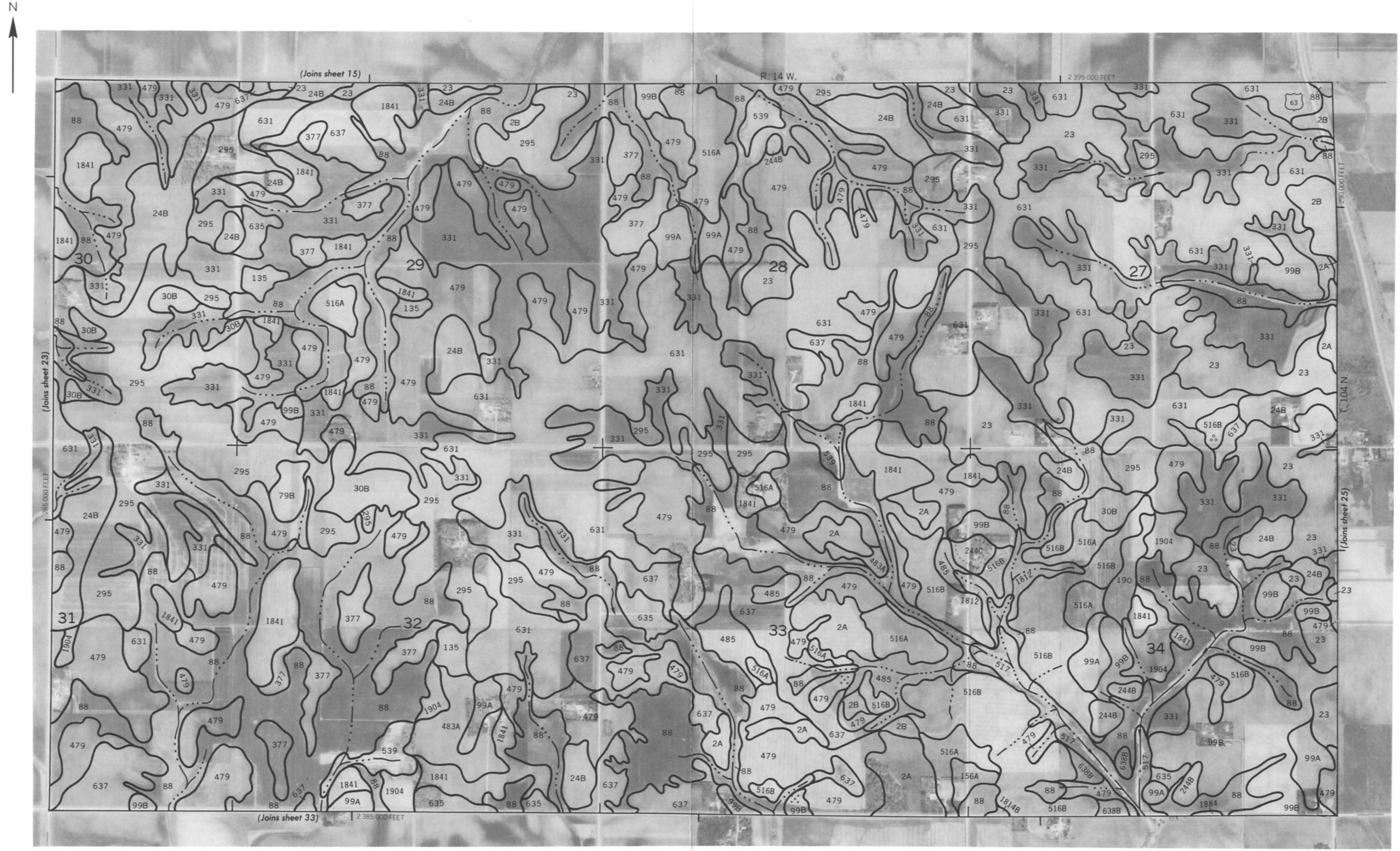
N

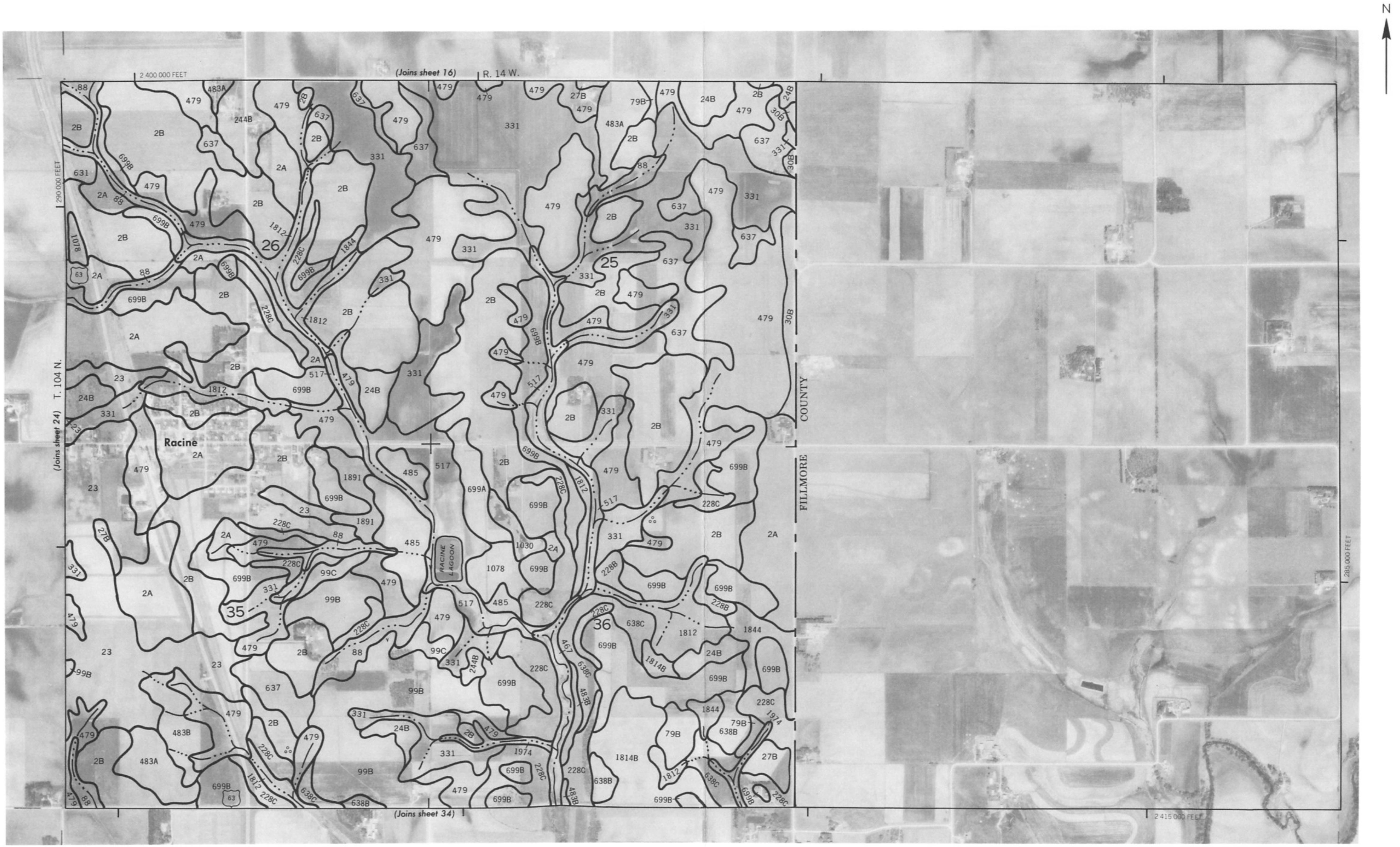

R. 16 W.
R. 15 W.
(Joins sheet 13)
2 360 000 FEET
290 000 FEET
T. 104 N.
(Joins sheet 23)
(Joins sheet 21)
285 000 FEET
2 345 000 FEET
(Joins sheet 31)
25
30
29
28
36
31
32
33
North Fork
Bear Creek
90
331
295
631
88
479
24B
23
637
517
2B
30B
2A
485
483A

MOWER COUNTY, MINNESOTA — SHEET NUMBER 23

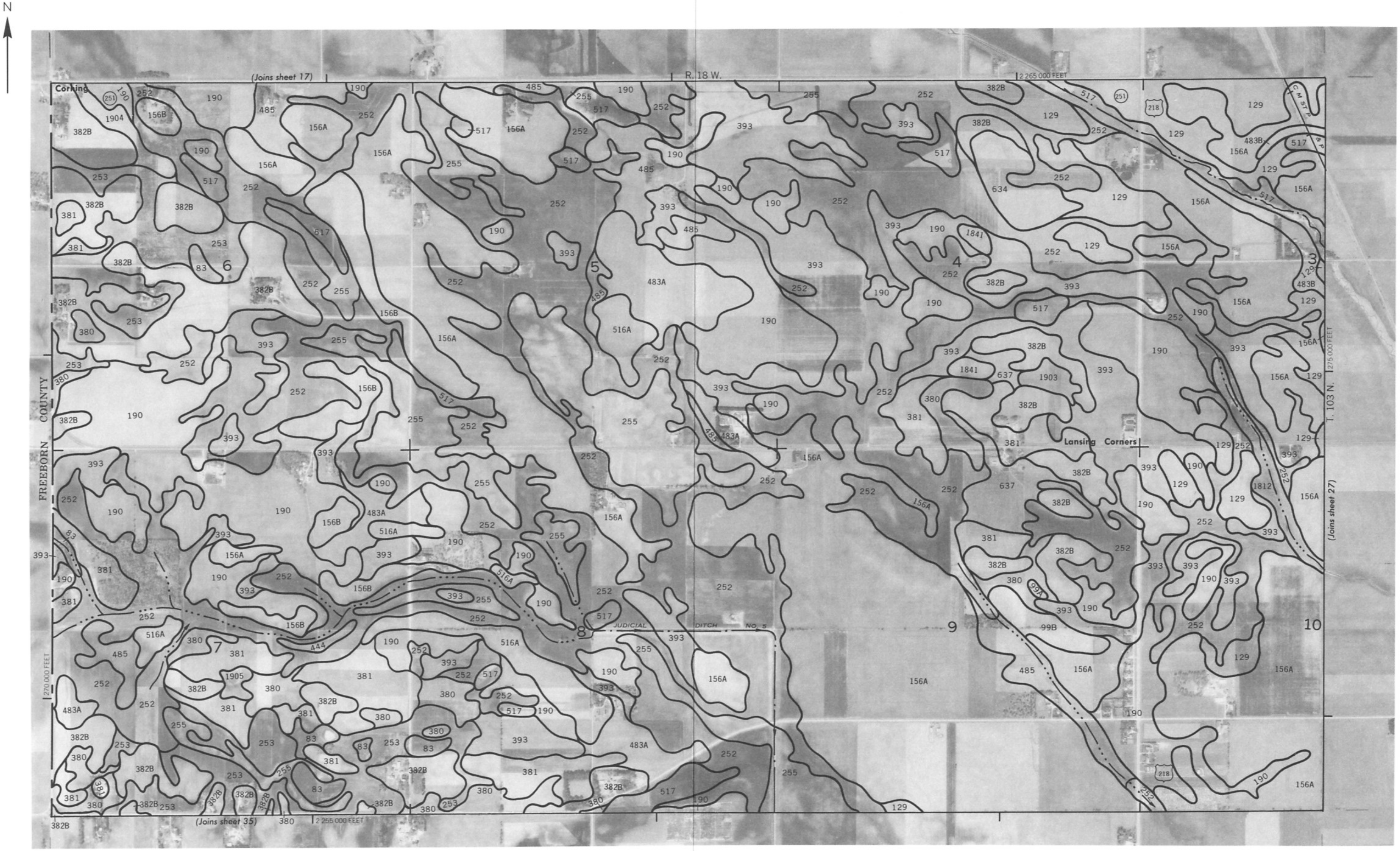

N
(Joins sheet 14)
R. 15 W.
R. 14 W.
(Joins sheet 24)
(Joins sheet 32)
(Joins sheet 22)
T. 104 N.
2 365 000 FEET
2 380 000 FEET
290 000 FEET
285 000 FEET
90
27
26
25
30
34
35
36
31
North Fork Bear Creek

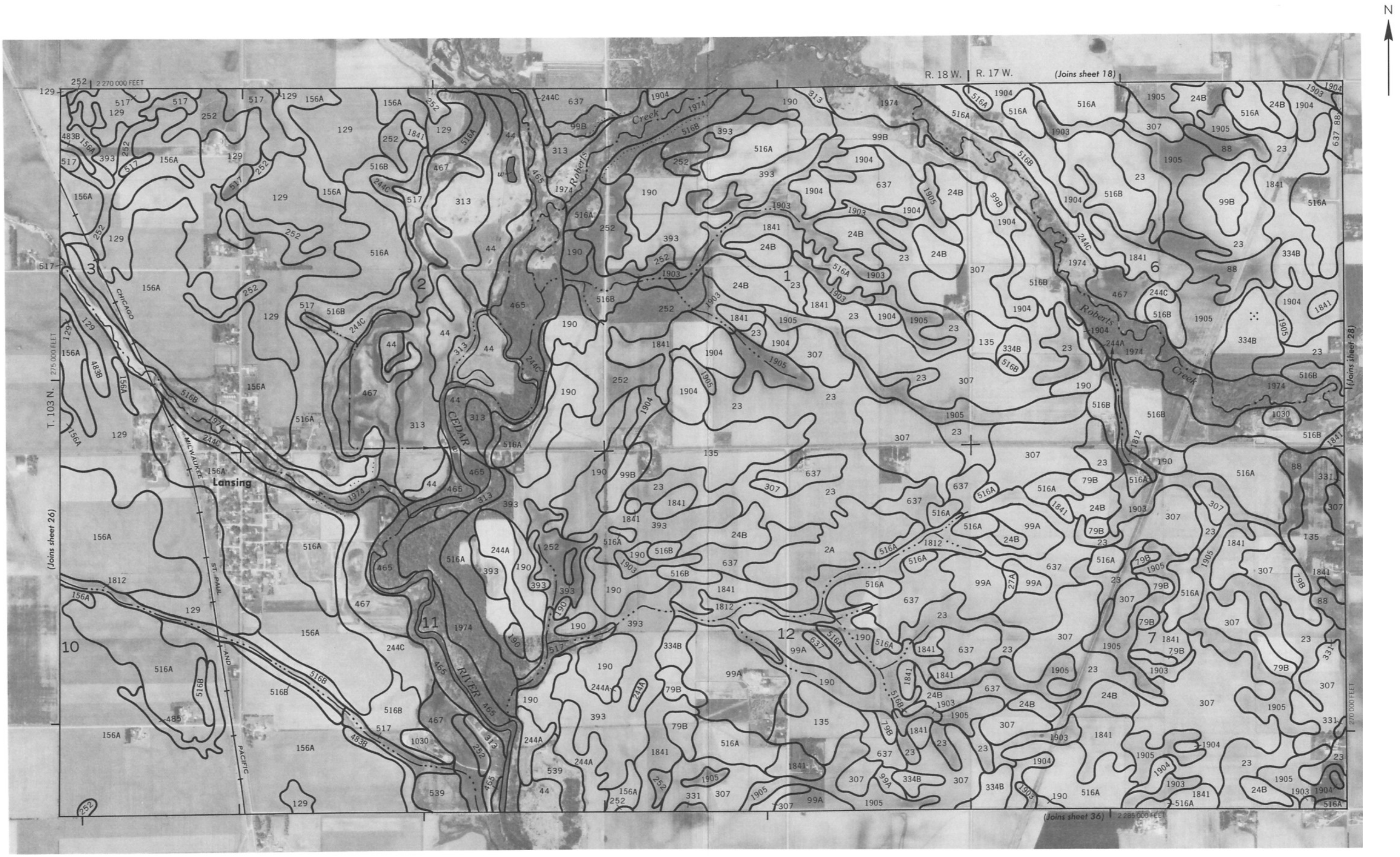
MOWER COUNTY, MINNESOTA — SHEET NUMBER 24

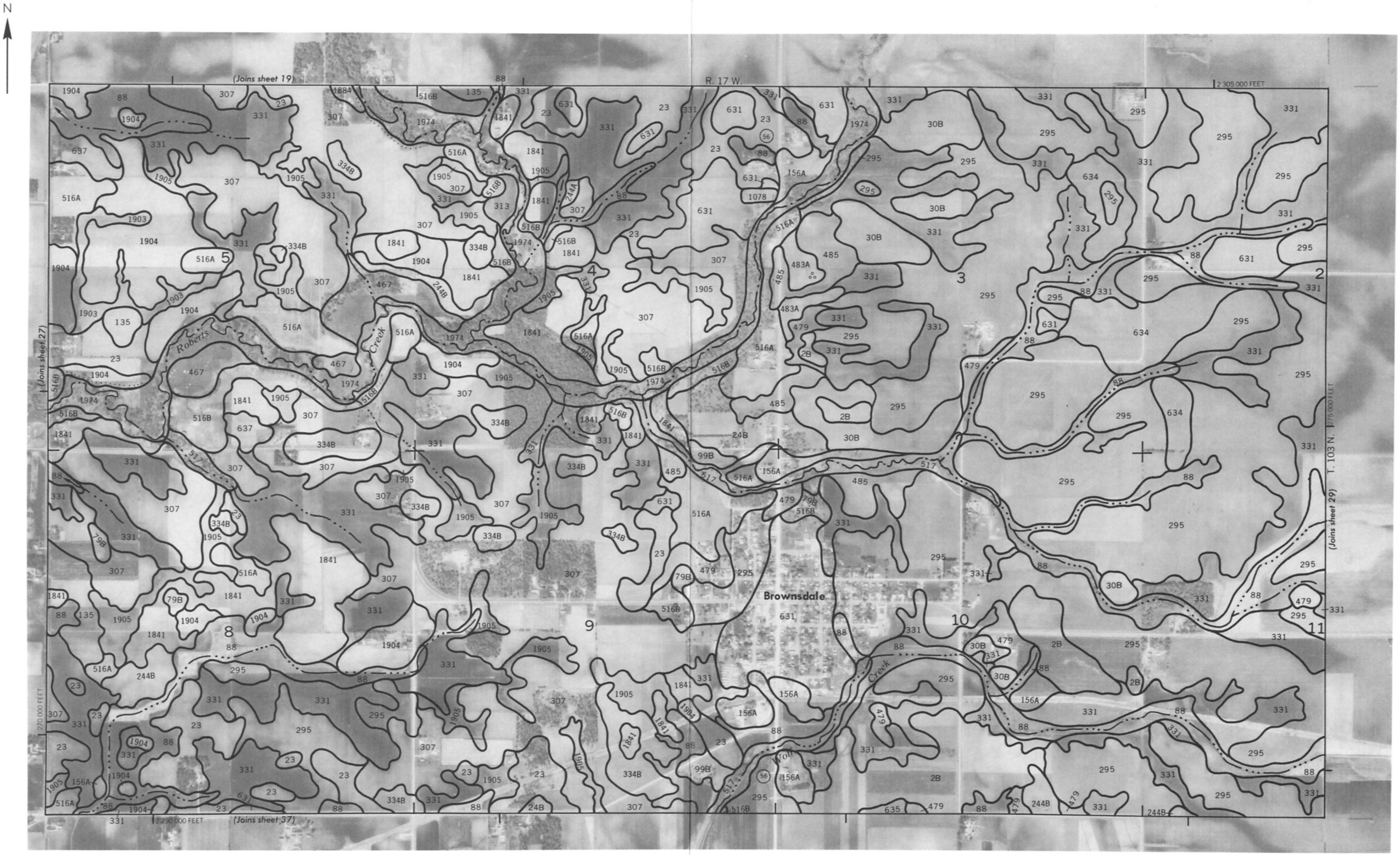

N
(Joins sheet 15)
R. 14 W.
2 395 000 FEET
290 000 FEET
63
T. 104 N.
(Joins sheet 25)
(Joins sheet 23)
285 000 FEET
(Joins sheet 33)
2 385 000 FEET
30
29
28
27
31
32
33
34


N
(Joins sheet 16)
R. 14 W.
2 400 000 FEET
290 000 FEET
T. 104 N.
(Joins sheet 24)
Racine
63
26
25
35
36
RACINE LAGOON
COUNTY
FILLMORE
(Joins sheet 34)
2 415 000 FEET
285 000 FEET

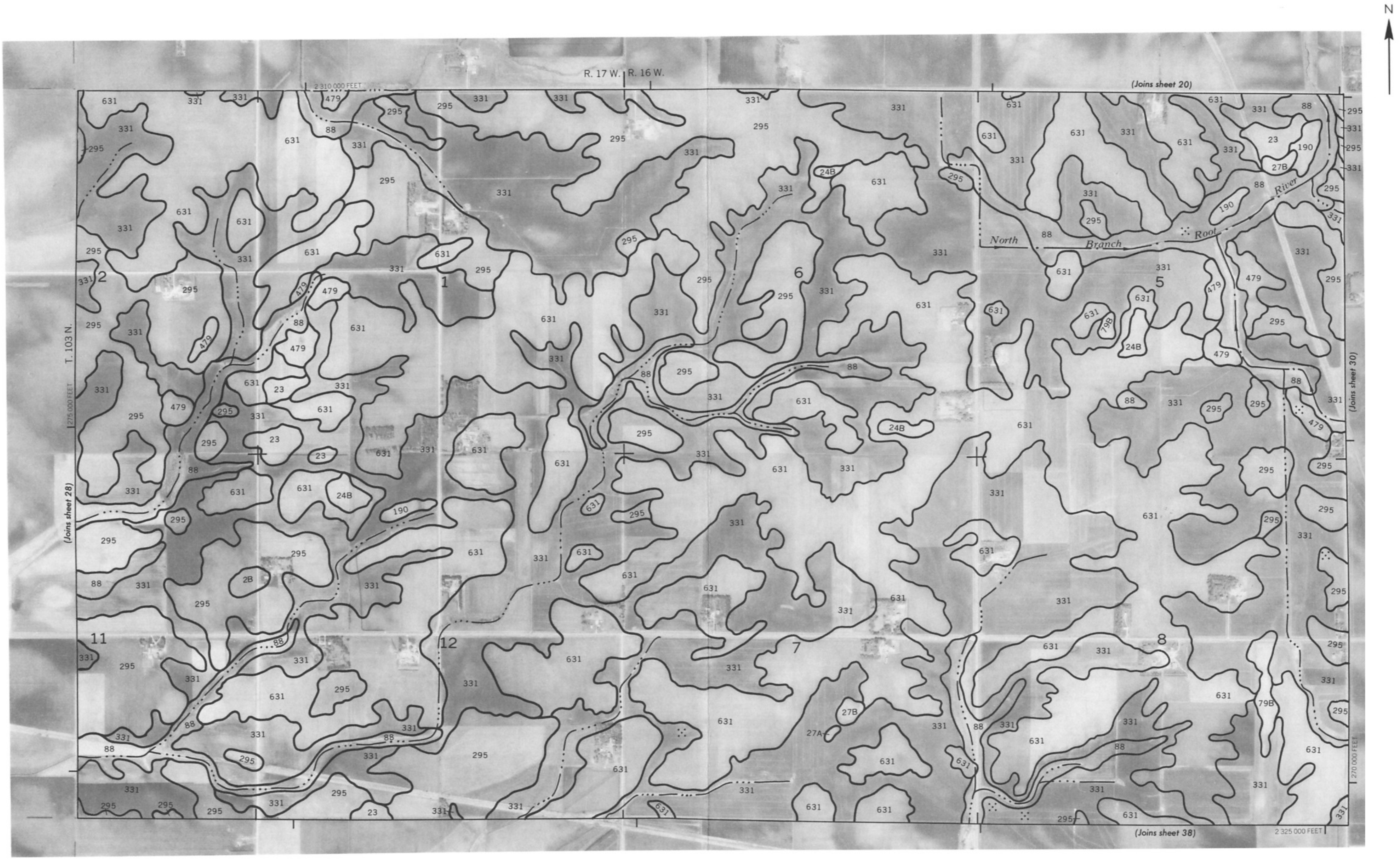
MOWER COUNTY, MINNESOTA — SHEET NUMBER 26


N
Corning
(Joins sheet 17)
R. 18 W.
2 265 000 FEET
FREEBORN COUNTY
T. 103 N.
275 000 FEET
(Joins sheet 27)
Lansing Corners
JUDICIAL DITCH NO. 5
270 000 FEET
(Joins sheet 35)
2 255 000 FEET
C M ST P & P
251
218
3
4
5
6
7
8
9
10

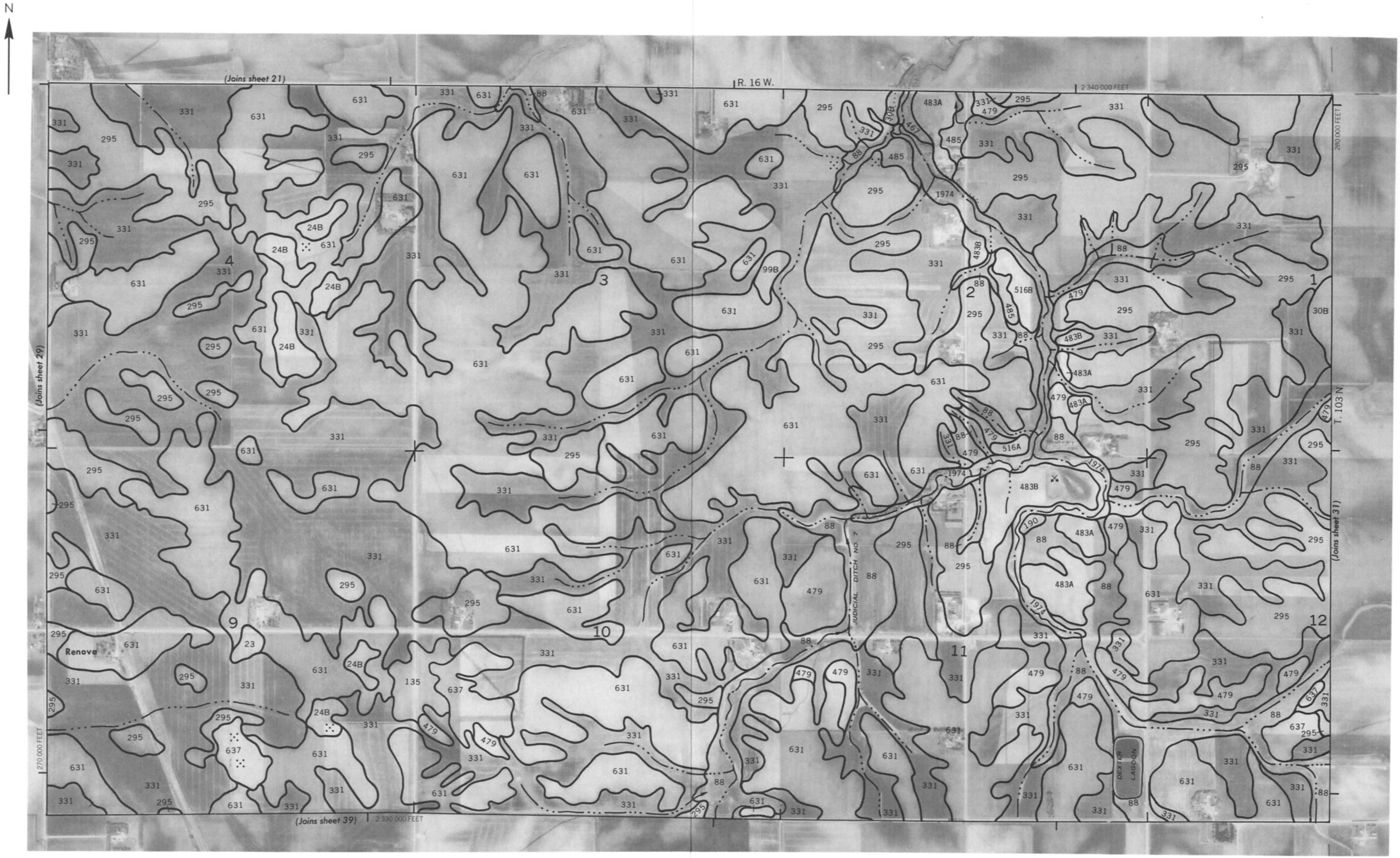

N
R. 18 W.
R. 17 W.
(Joins sheet 18)
(Joins sheet 28)
(Joins sheet 36)
(Joins sheet 26)
T. 103 N.
2 270 000 FEET
275 000 FEET
2 285 000 FEET
270 000 FEET
Lansing
CEDAR
RIVER
Roberts
Creek
CHICAGO
MILWAUKEE
ST. PAUL
AND
PACIFIC
1
2
3
6
7
10
11
12


N
(Joins sheet 19)
R. 17 W.
2 305 000 FEET
(Joins sheet 27)
(Joins sheet 29)
T. 103 N.
275 000 FEET
270 000 FEET
2 290 000 FEET
(Joins sheet 37)
Roberts Creek
Wolf Creek
Brownsdale
56
2
3
4
5
8
9
10
11

MOWER COUNTY, MINNESOTA — SHEET NUMBER 29


N
R. 17 W.
R. 16 W.
2 310 000 FEET
(Joins sheet 20)
(Joins sheet 28)
(Joins sheet 30)
(Joins sheet 38)
T. 103 N.
275 000 FEET
270 000 FEET
2 325 000 FEET
North Branch Root River
1
2
5
6
7
8
11
12
23
24B
27A
27B
2B
79B
88
190
295
331
479
631

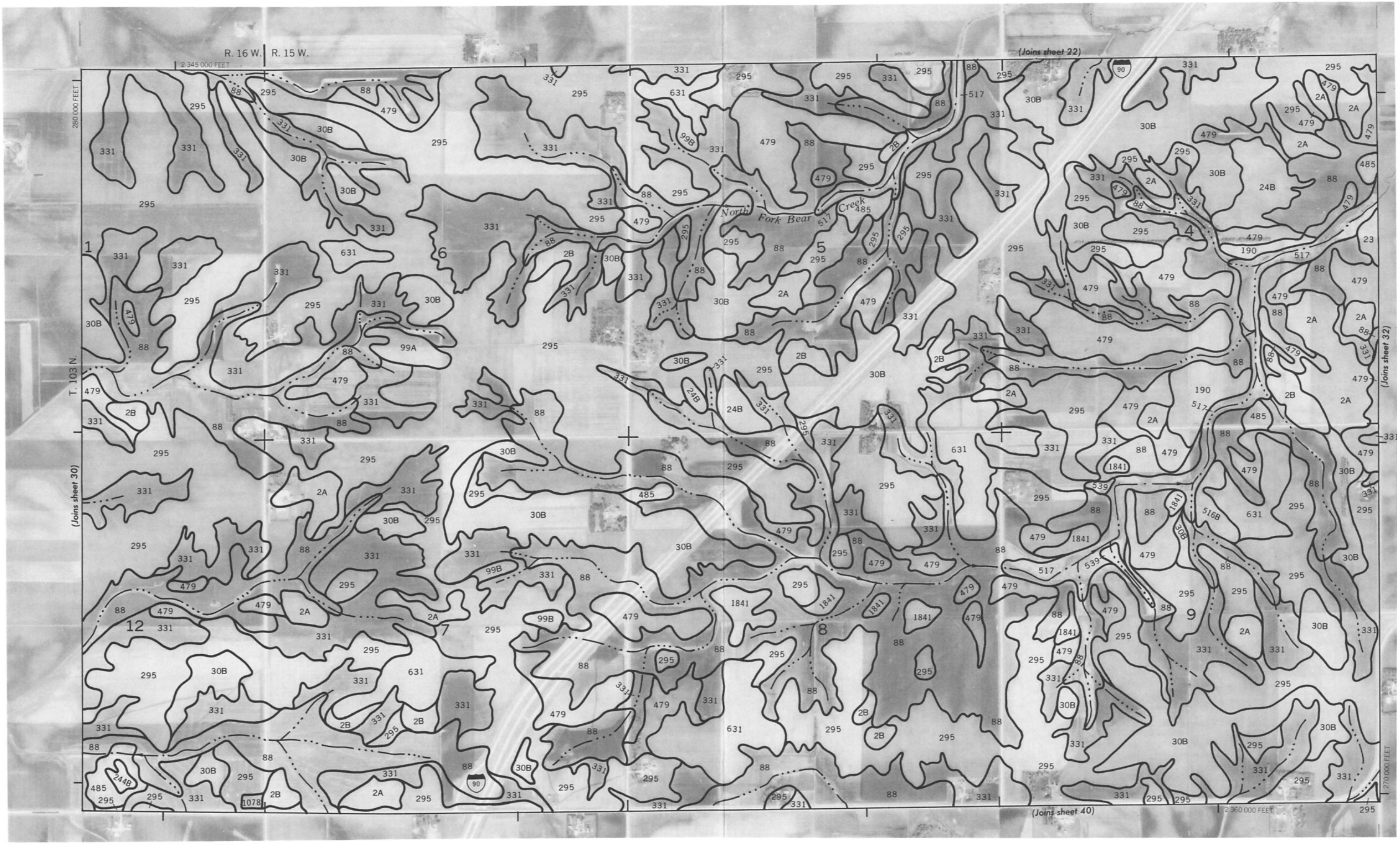
MOWER COUNTY, MINNESOTA — SHEET NUMBER 30


N
(Joins sheet 21)
R. 16 W.
2 340 000 FEET
280 000 FEET
(Joins sheet 29)
T. 103 N.
(Joins sheet 31)
270 000 FEET
(Joins sheet 39)
2 330 000 FEET
1
2
3
4
9
10
11
12
Renova
JUDICIAL DITCH NO. 7
DEXTER LAGOON

MOWER COUNTY, MINNESOTA — SHEET NUMBER 31

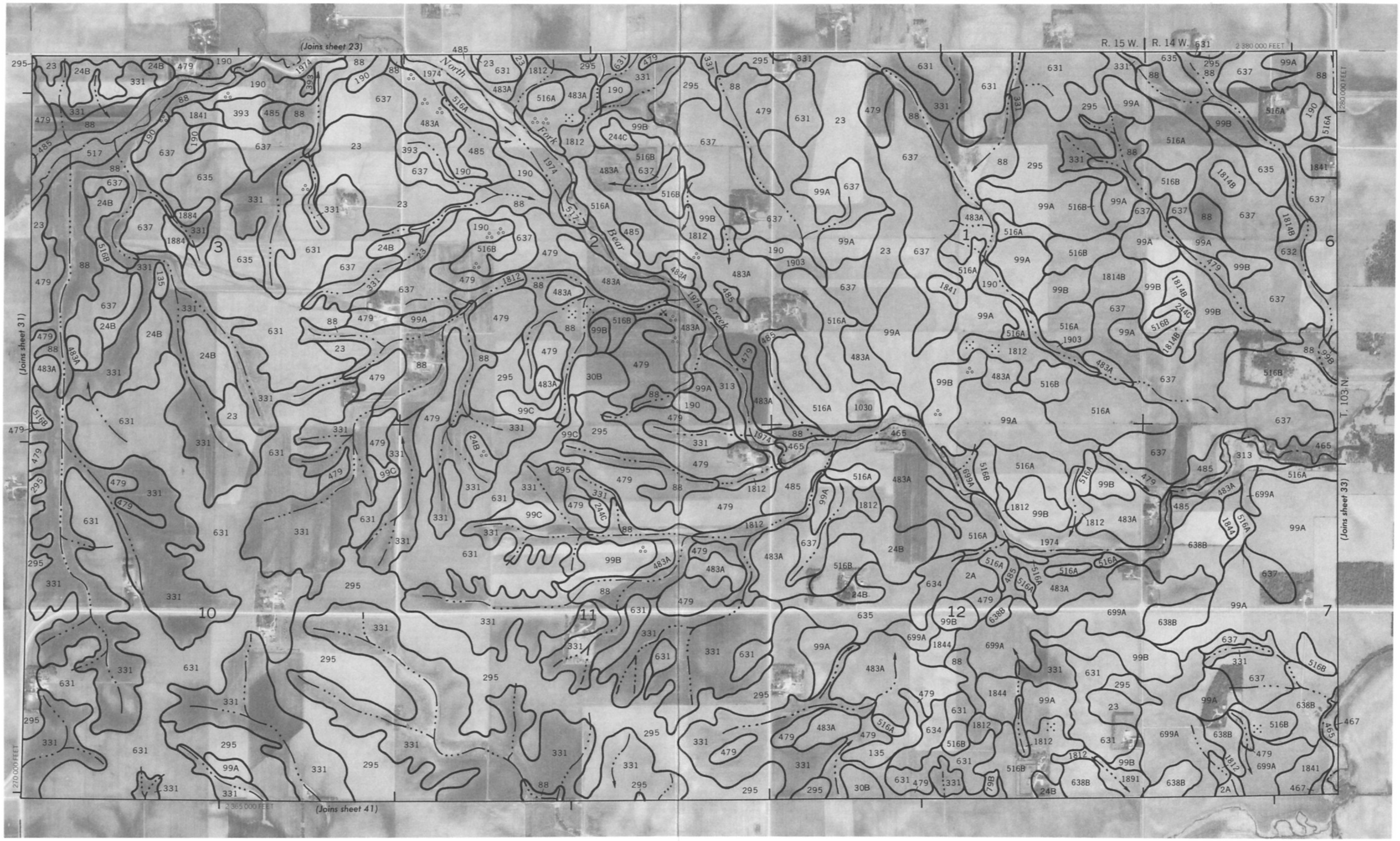
(31)

N

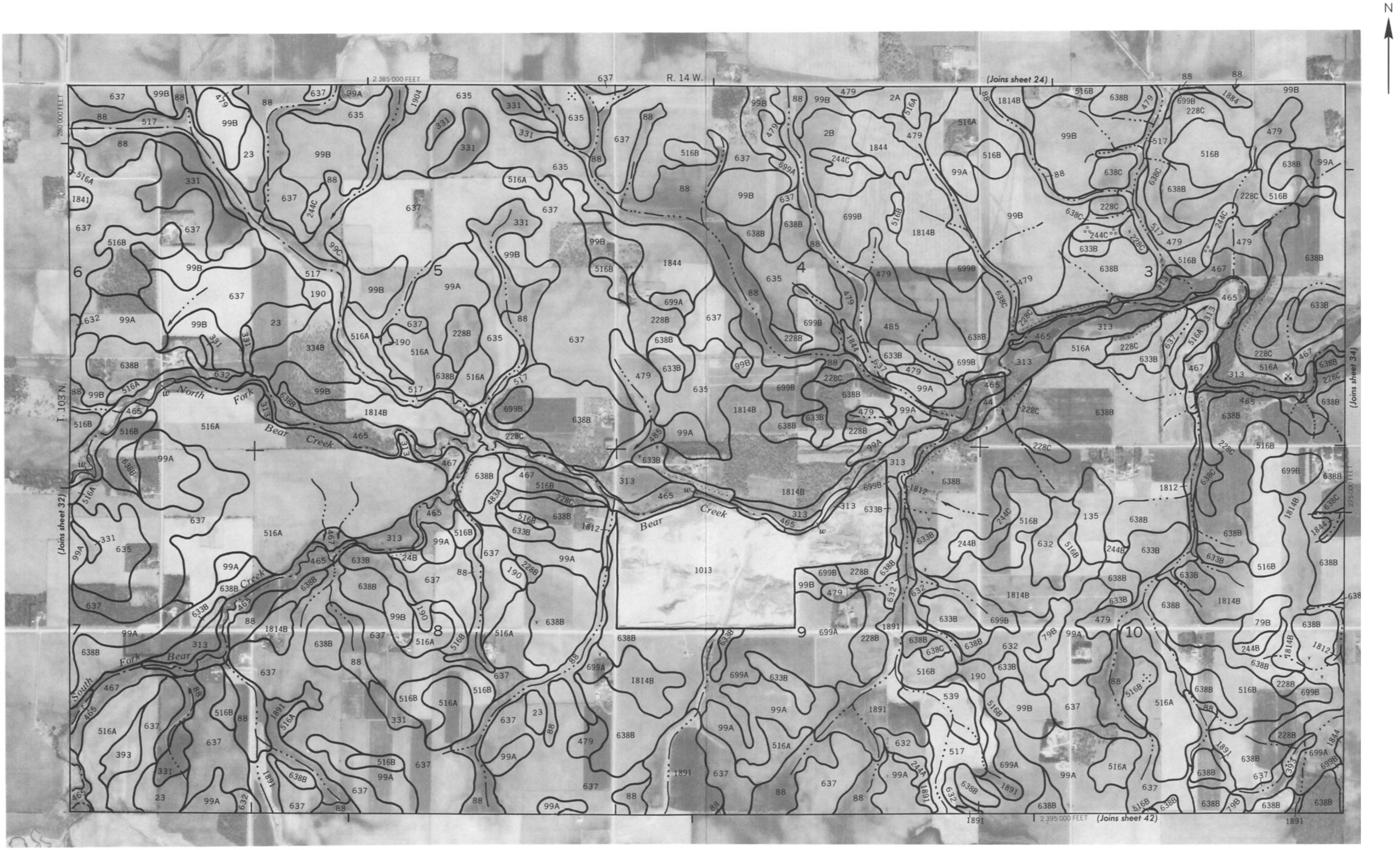

R. 16 W.
R. 15 W.
2 345 000 FEET
(Joins sheet 22)
280 000 FEET
T. 103 N.
(Joins sheet 30)
(Joins sheet 32)
(Joins sheet 40)
2 360 000 FEET
270 000 FEET
North Fork Bear Creek
90
1
4
5
6
7
8
9
12

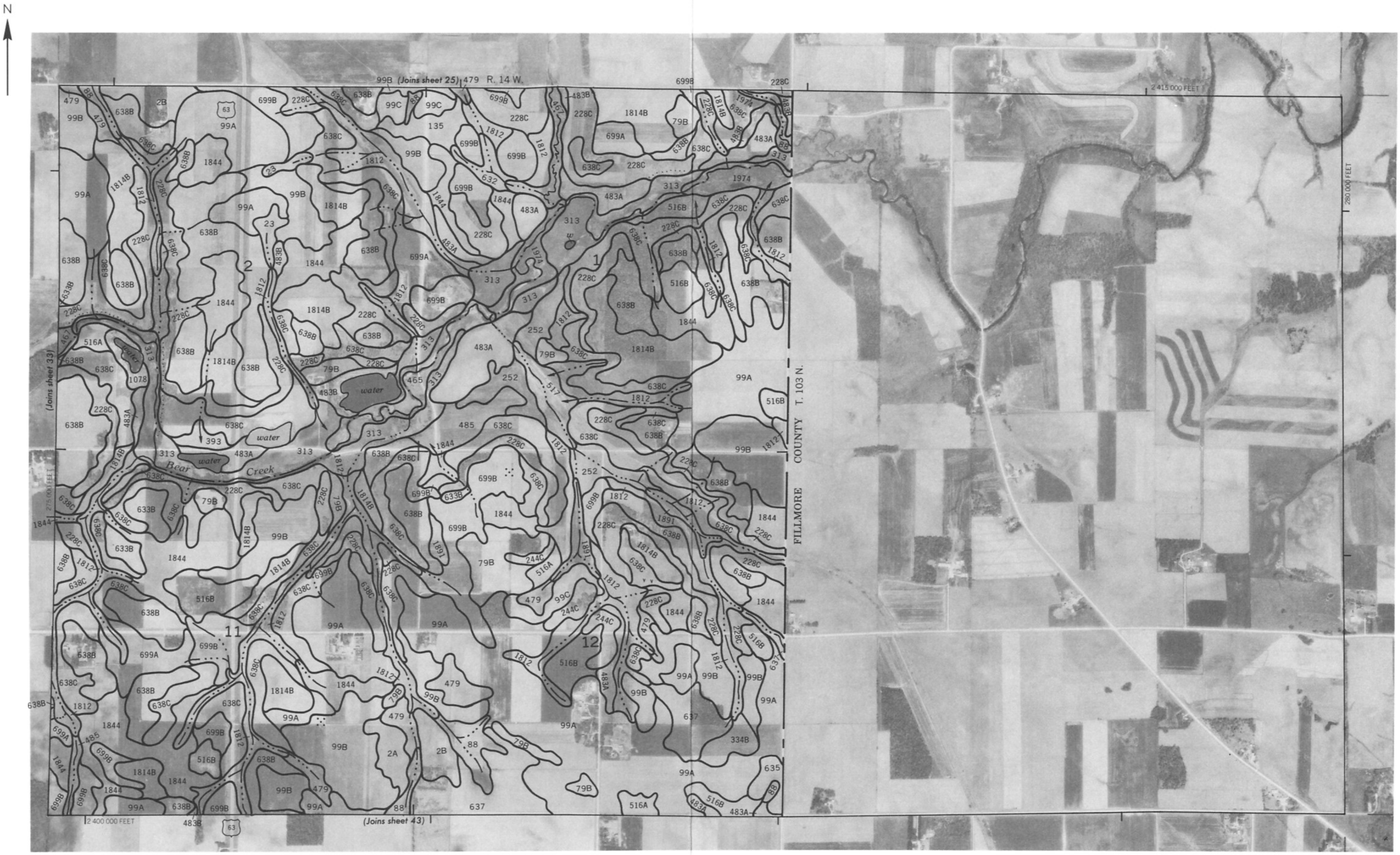
N

MOWER COUNTY, MINNESOTA — SHEET NUMBER 32

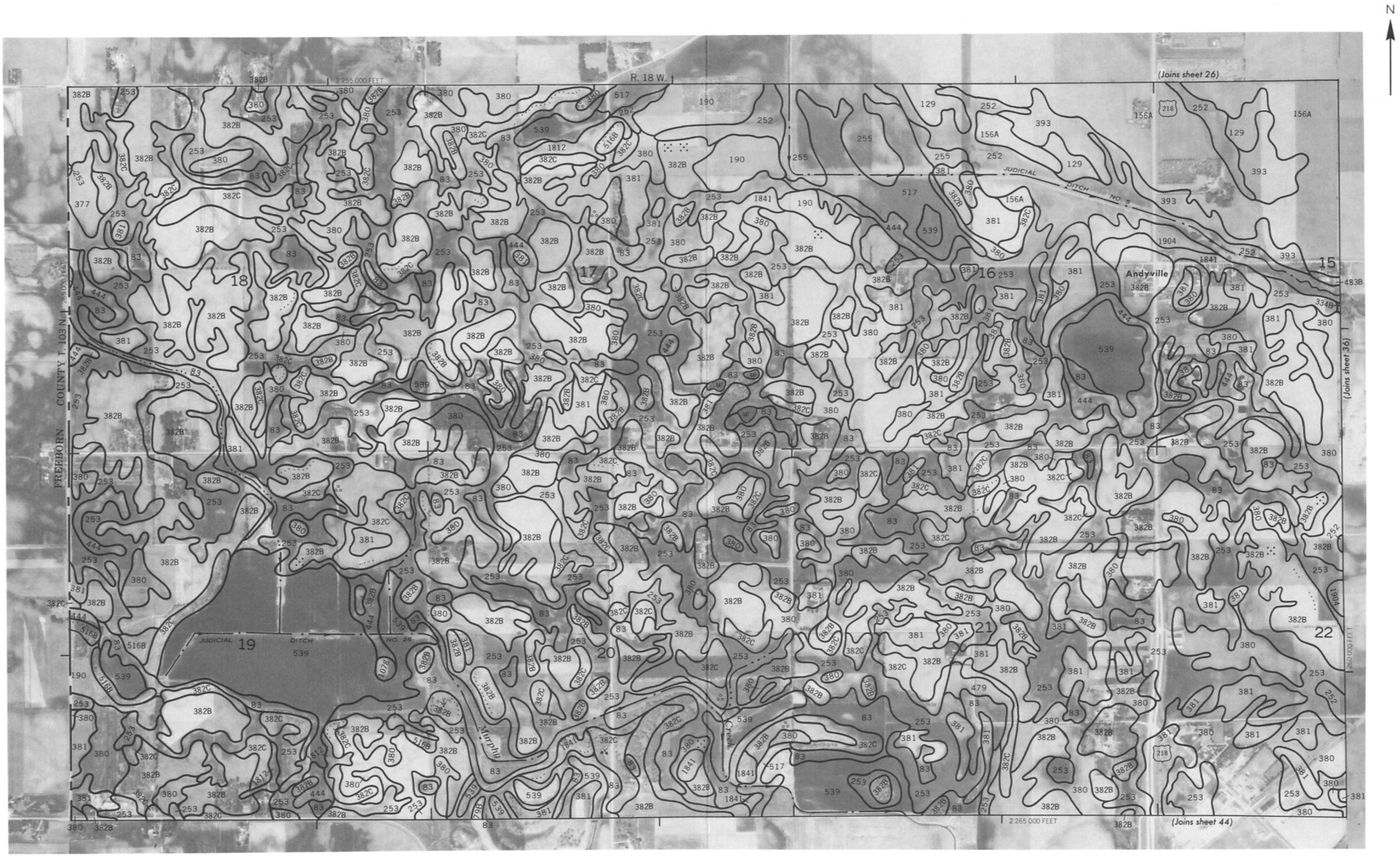

(Joins sheet 23)
(Joins sheet 31)
(Joins sheet 33)
(Joins sheet 41)
R. 15 W.
R. 14 W.
T. 103 N.
2 380 000 FEET
280 000 FEET
270 000 FEET
2 365 000 FEET
North Fork Bear Creek
1
2
3
6
7
10
11
12

MOWER COUNTY, MINNESOTA — SHEET NUMBER 33

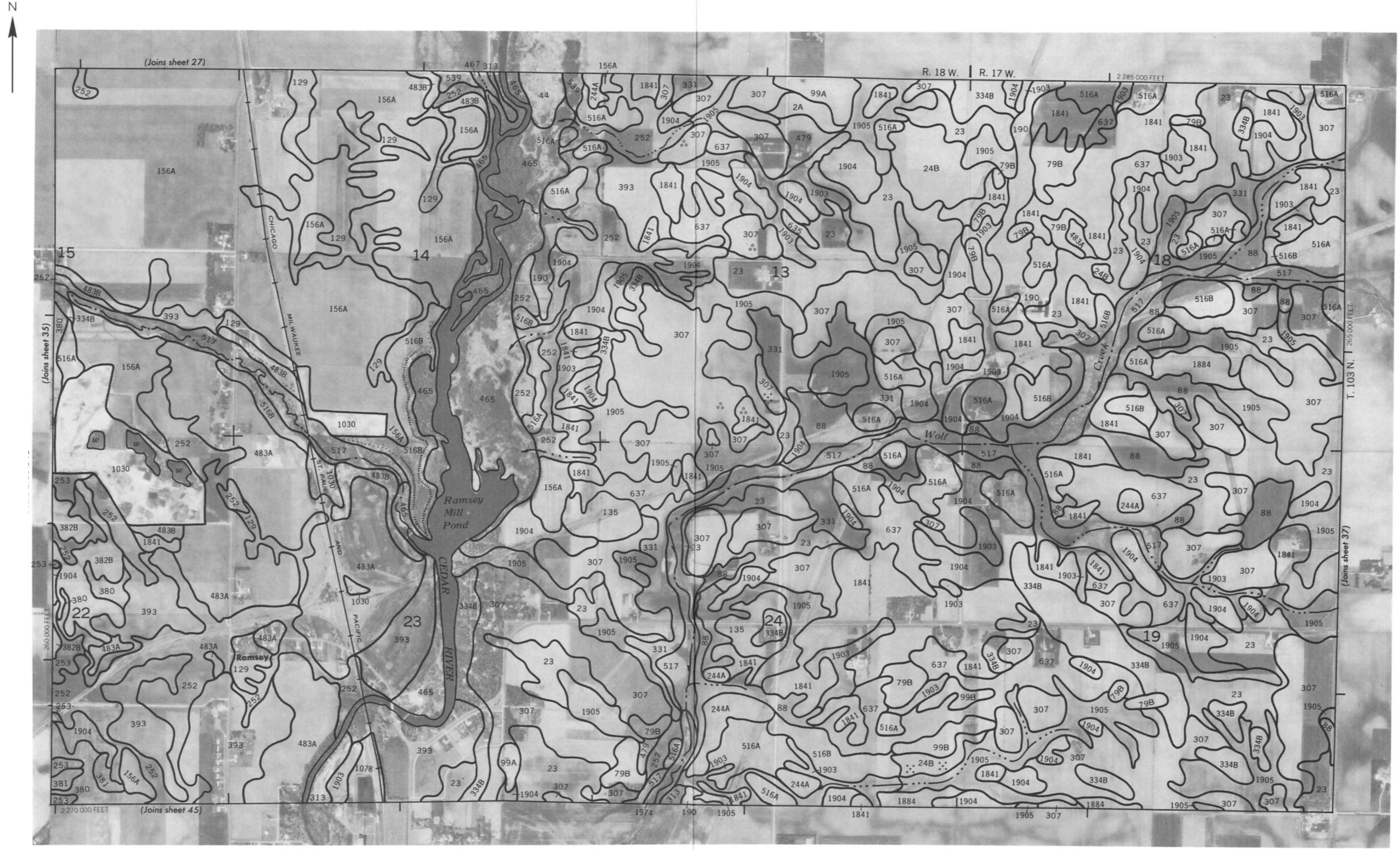

N
(Joins sheet 24)
R. 14 W.
2 385 000 FEET
280 000 FEET
T. 103 N.
(Joins sheet 32)
(Joins sheet 34)
275 000 FEET
2 395 000 FEET
(Joins sheet 42)
North Fork
Bear
Creek
Bear
Creek
South
Fork
Bear
Creek
3
4
5
6
7
8
9
10
1013

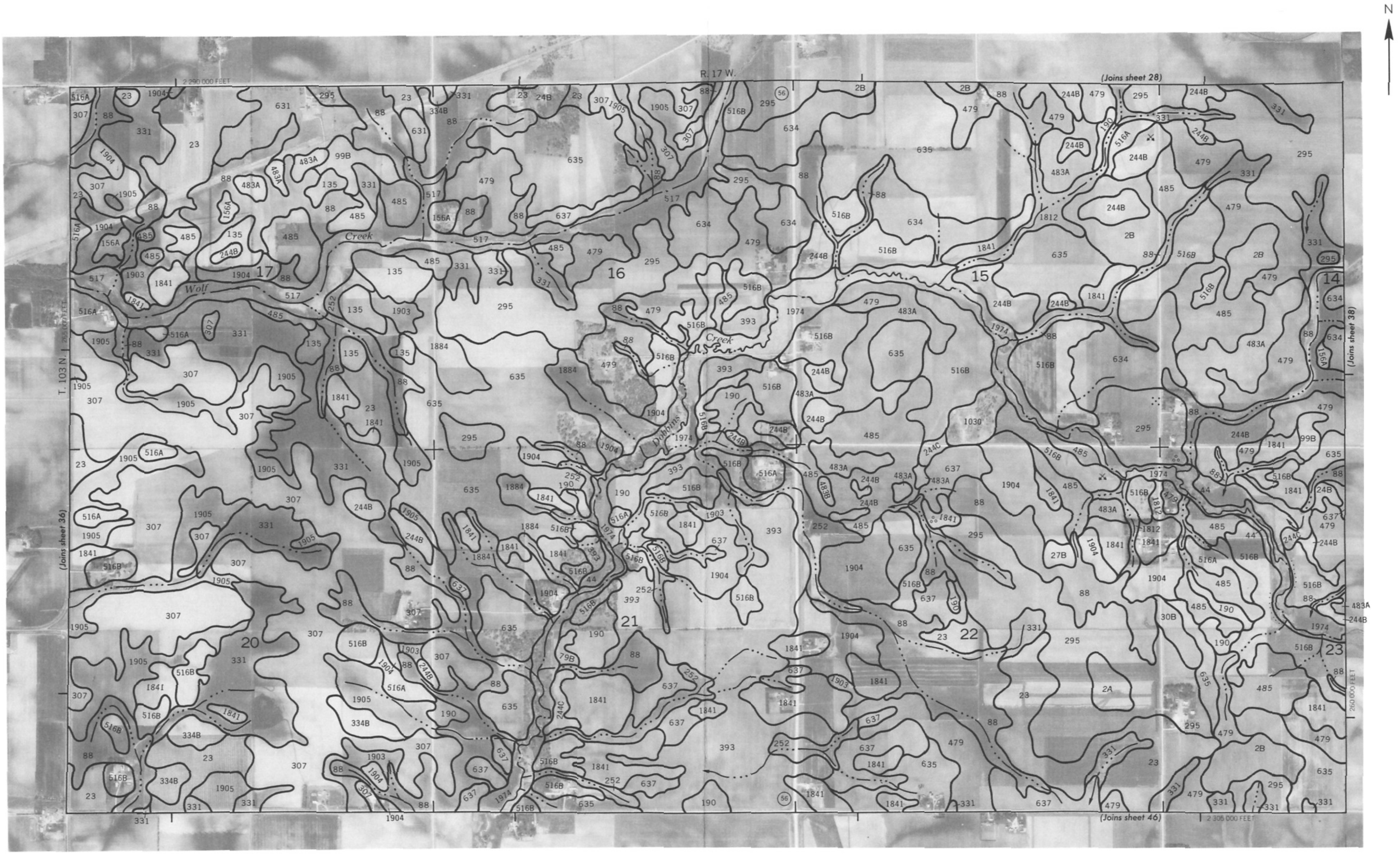

N
99B (Joins sheet 25) 479 R. 14 W.
699B
228C
2 415 000 FEET
280 000 FEET
(Joins sheet 33)
275 000 FEET
T. 103 N.
FILLMORE COUNTY
2 400 000 FEET
(Joins sheet 43)
63
Bear Creek
water
1
2
11
12
99A
99B
99C
135
228C
313
483A
483B
516A
516B
638B
638C
699A
699B
1812
1814B
1844
1974
252
465
485
517
393
1078
633B
79B
2A
2B
88
23
244C
334B
479
632
635
637
1891

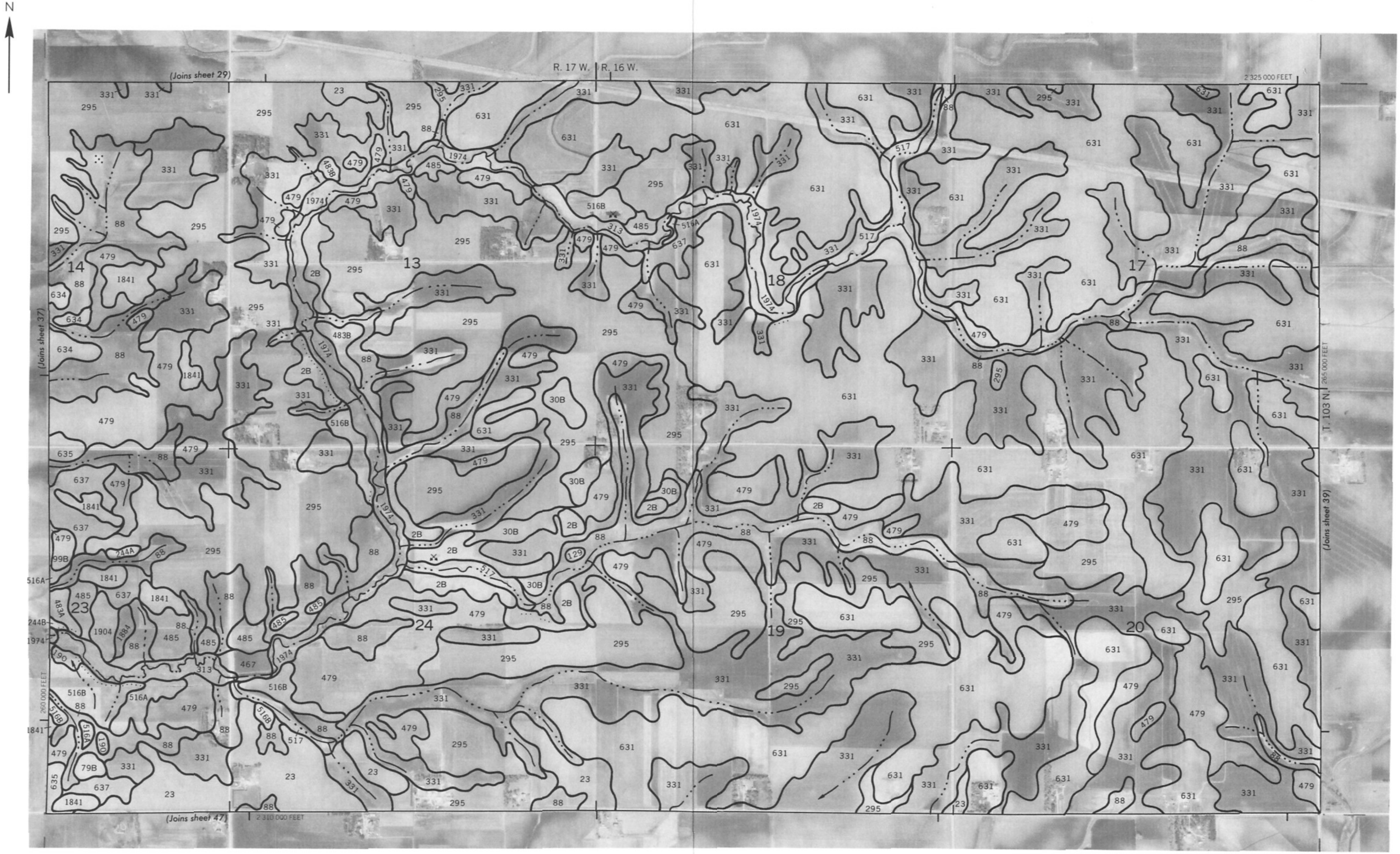
MOWER COUNTY, MINNESOTA — SHEET NUMBER 35

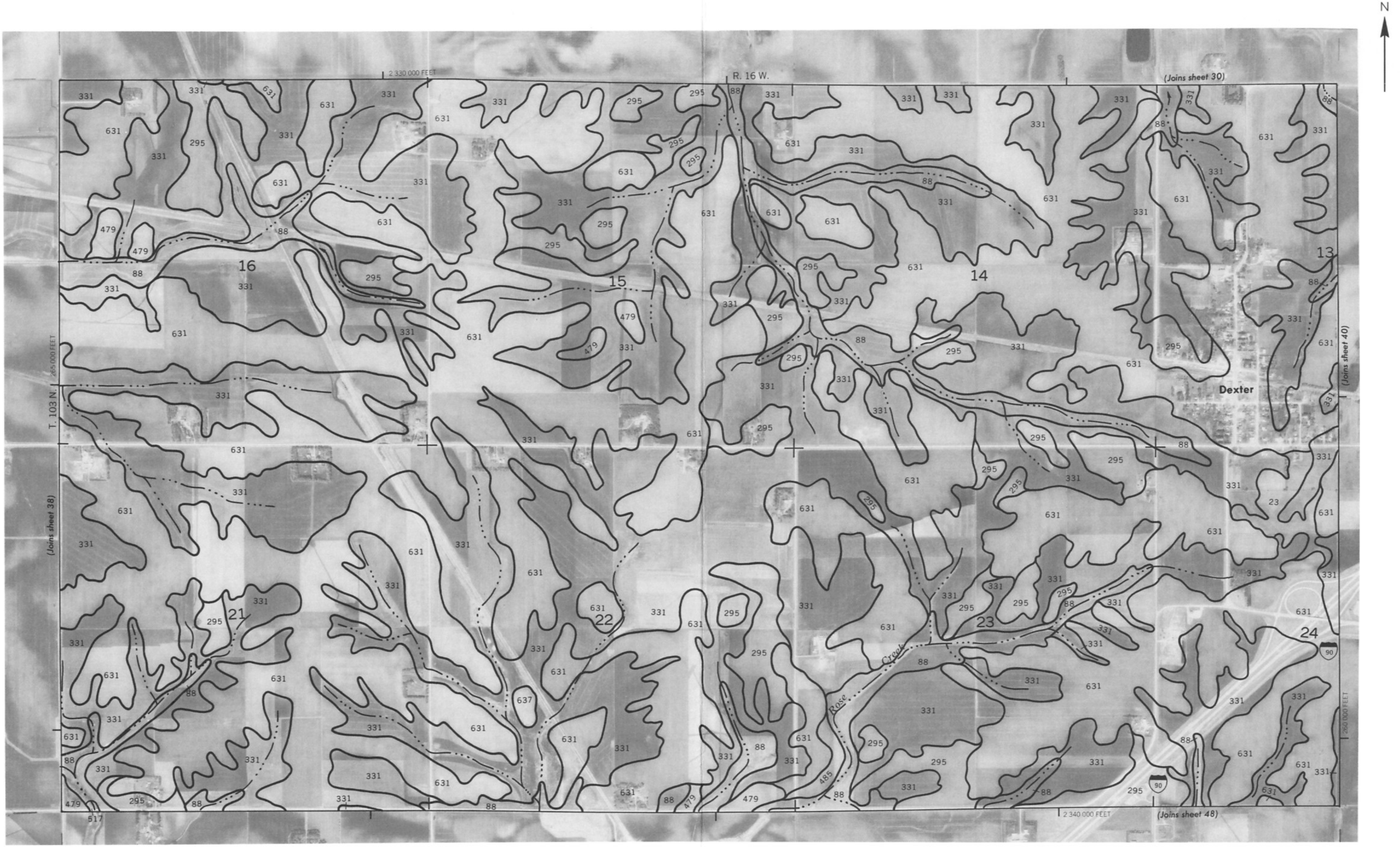

N
R. 18 W.
2 255 000 FEET
(Joins sheet 26)
(Joins sheet 36)
(Joins sheet 44)
2 265 000 FEET
260 000 FEET
265 000 FEET
FREEBORN COUNTY T. 103 N.
Andyville
218
JUDICIAL DITCH NO. 5
JUDICIAL DITCH NO. 26
Murphy Creek
15
16
17
18
19
20
21
22

MOWER COUNTY, MINNESOTA — SHEET NUMBER 36


N
(Joins sheet 27)
R. 18 W.
R. 17 W.
2 285 000 FEET
(Joins sheet 35)
(Joins sheet 37)
(Joins sheet 45)
T. 103 N.
265 000 FEET
260 000 FEET
2 270 000 FEET
CHICAGO
MILWAUKEE
ST. PAUL
AND
PACIFIC
Ramsey Mill Pond
CEDAR
RIVER
Wolf
Creek
Ramsey
13
14
15
18
19
22
23
24

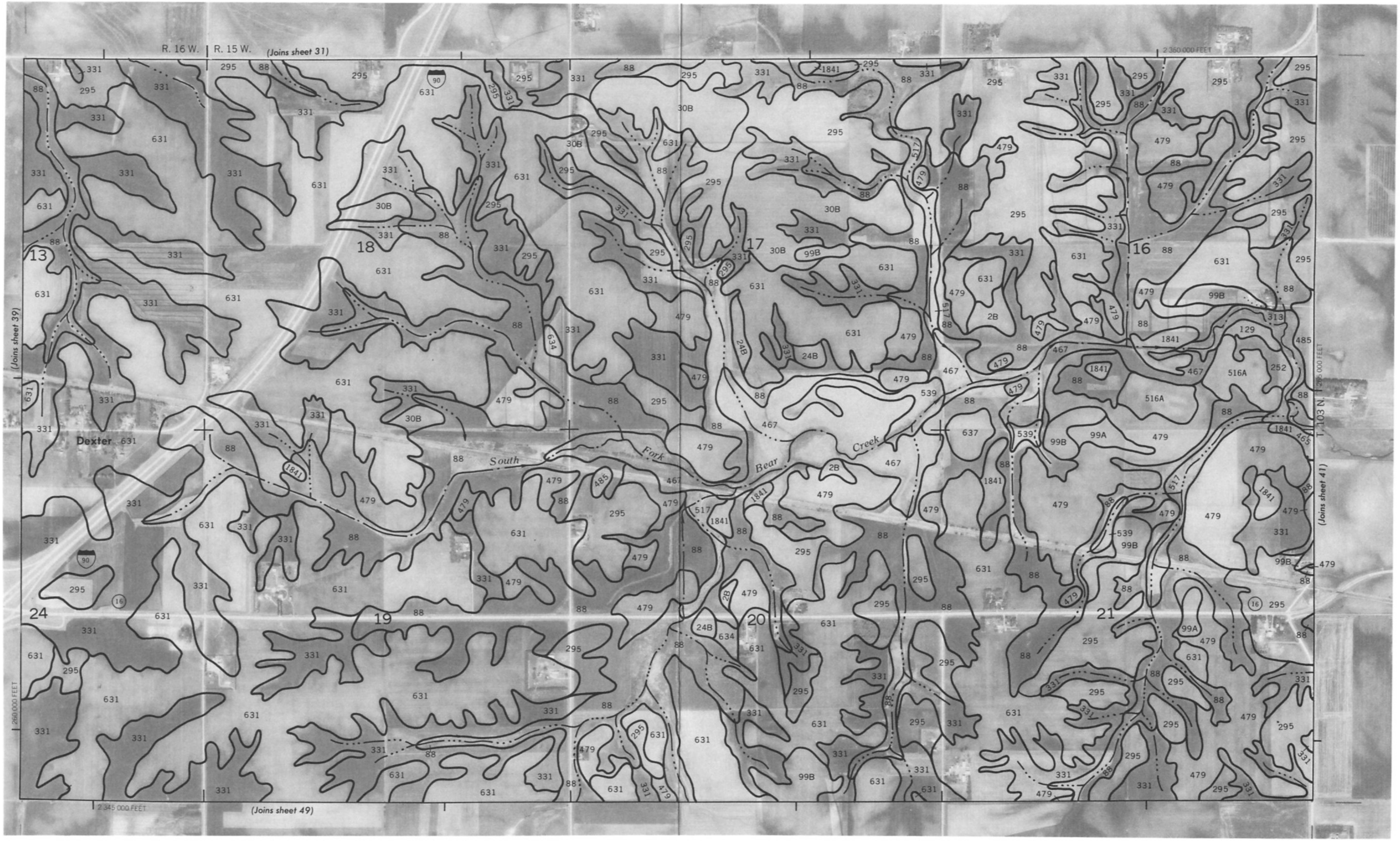

N
R. 17 W.
T. 103 N.
2 290 000 FEET
2 305 000 FEET
260 000 FEET
(Joins sheet 28)
(Joins sheet 36)
(Joins sheet 38)
(Joins sheet 46)
Wolf Creek
Dobbins Creek
56
14
15
16
17
20
21
22
23


N
(Joins sheet 29)
R. 17 W.
R. 16 W.
2 325 000 FEET
(Joins sheet 37)
(Joins sheet 39)
265 000 FEET
T. 103 N.
260 000 FEET
(Joins sheet 47)
2 310 000 FEET
13
14
17
18
19
20
23
24


N
(Joins sheet 30)
(Joins sheet 38)
(Joins sheet 40)
(Joins sheet 48)
R. 16 W.
T. 103 N.
2 330 000 FEET
2 340 000 FEET
265 000 FEET
260 000 FEET
Dexter
Rose Creek
16
15
14
13
21
22
23
24
90

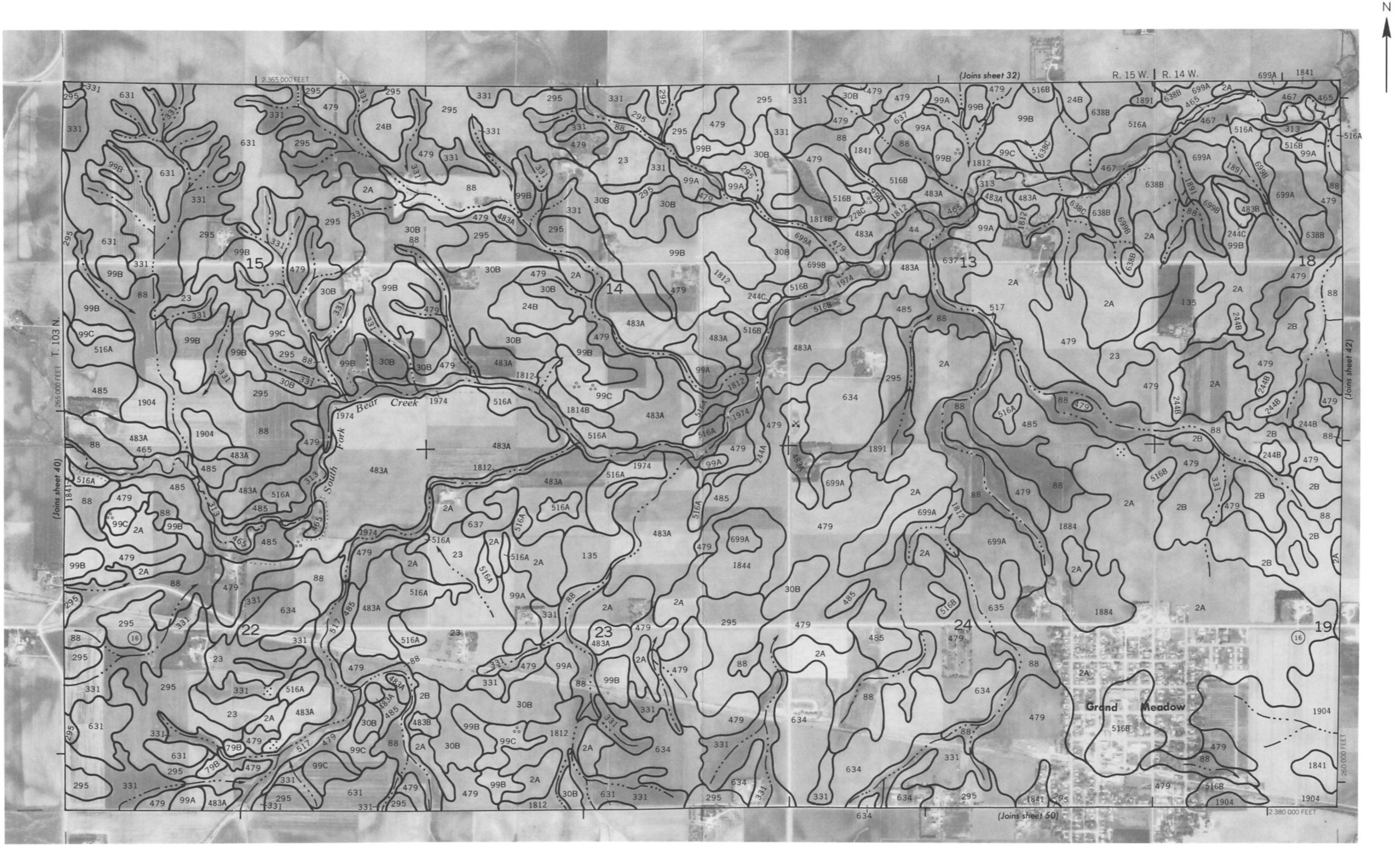
MOWER COUNTY, MINNESOTA — SHEET NUMBER 40

N

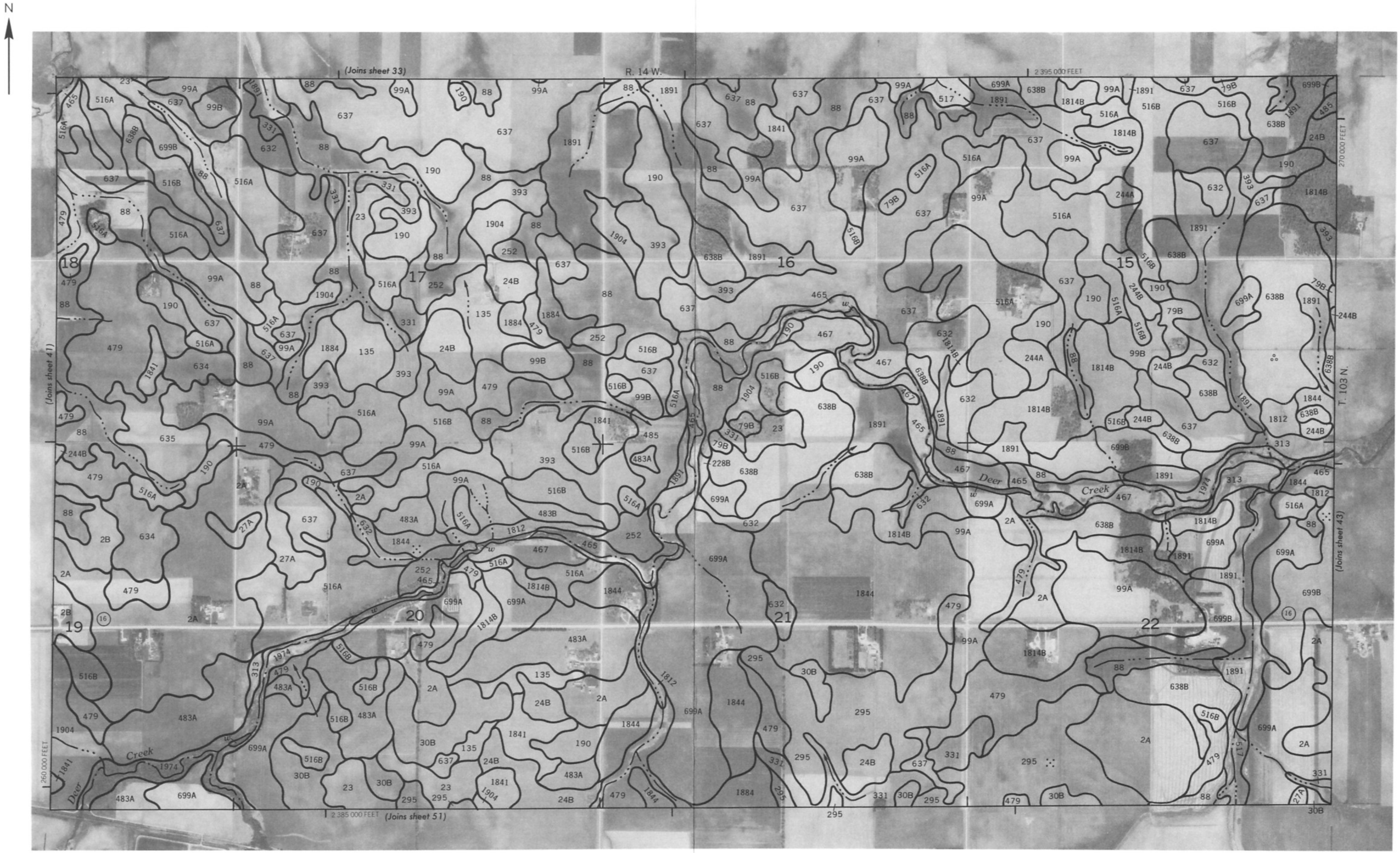

R. 16 W.
R. 15 W.
(Joins sheet 31)
(Joins sheet 39)
(Joins sheet 41)
(Joins sheet 49)
2 360 000 FEET
2 345 000 FEET
260 000 FEET
T. 103 N.
Dexter
South Fork Bear Creek
90
16
13
18
17
16
24
19
20
21

MOWER COUNTY, MINNESOTA — SHEET NUMBER 41

㊶

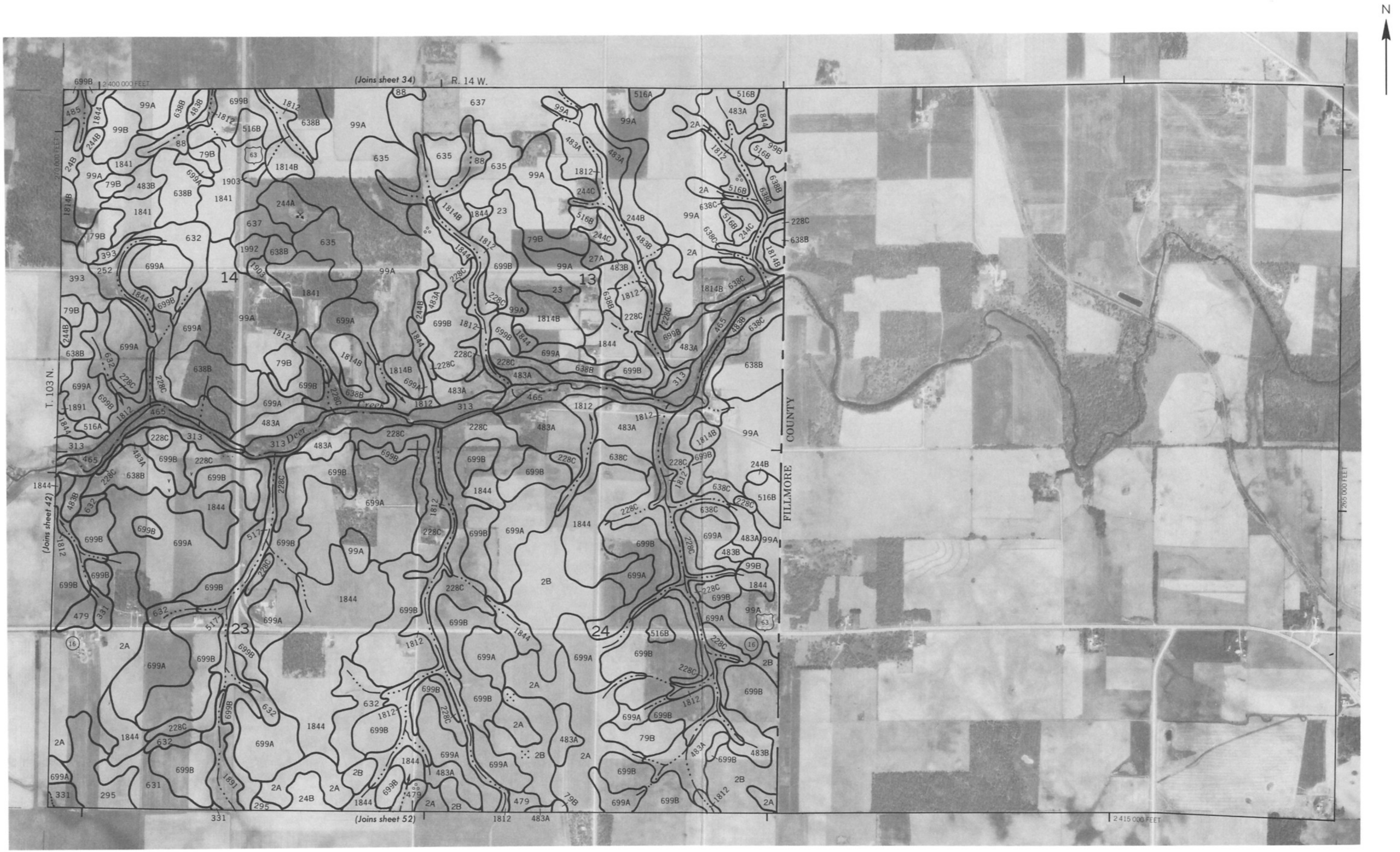

N
(Joins sheet 32)
R. 15 W.
R. 14 W.
2 365 000 FEET
T. 103 N.
265 000 FEET
(Joins sheet 40)
(Joins sheet 42)
(Joins sheet 50)
2 380 000 FEET
260 000 FEET
South Fork Bear Creek
Grand Meadow
15
14
13
18
22
23
24
19
16

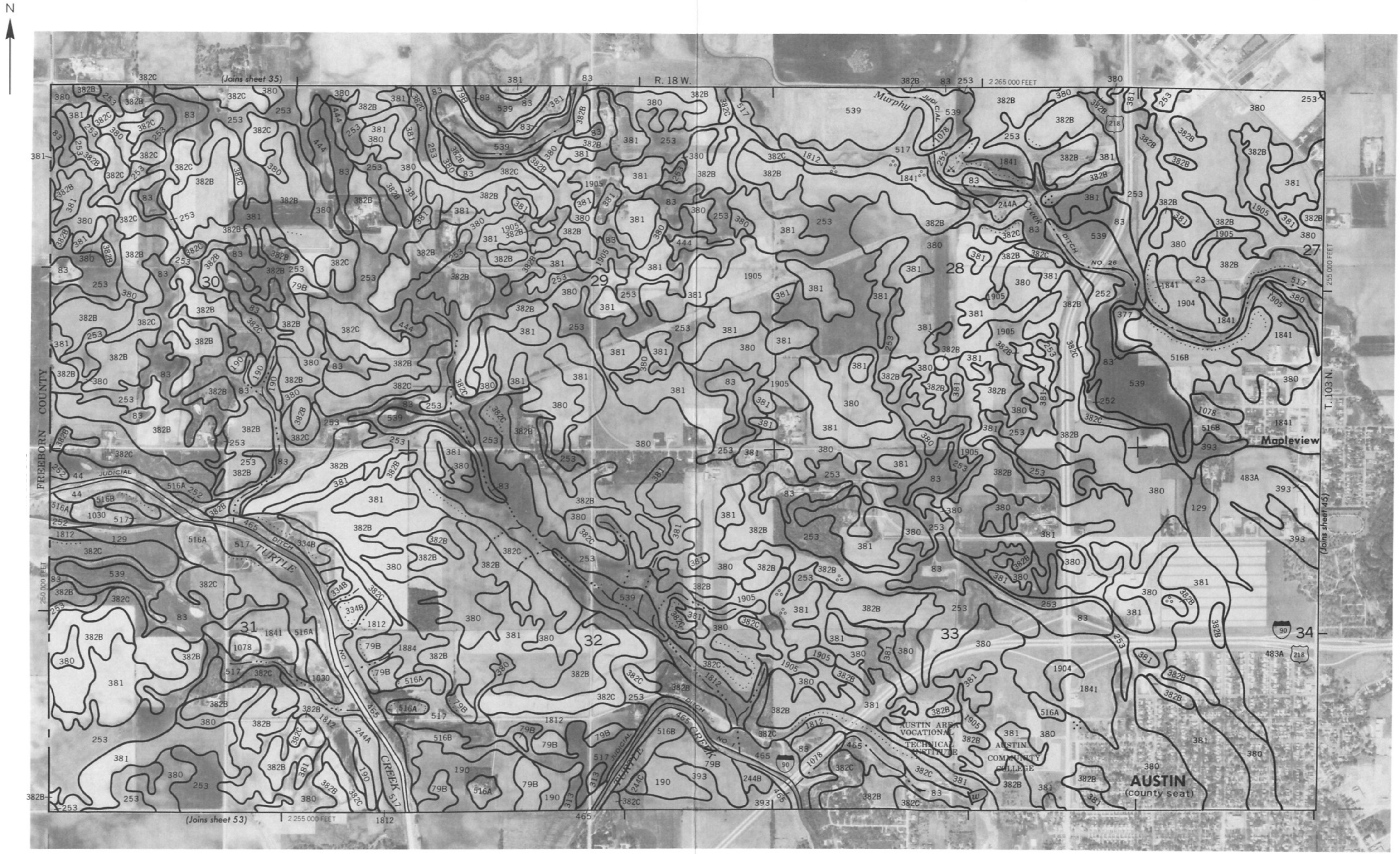
MOWER COUNTY, MINNESOTA — SHEET NUMBER 42


N
(Joins sheet 33)
R. 14 W.
2 395 000 FEET
270 000 FEET
T. 103 N.
(Joins sheet 43)
(Joins sheet 41)
260 000 FEET
2 385 000 FEET
(Joins sheet 51)
18
17
16
15
19
20
21
22
Deer Creek
Creek
Deer
16

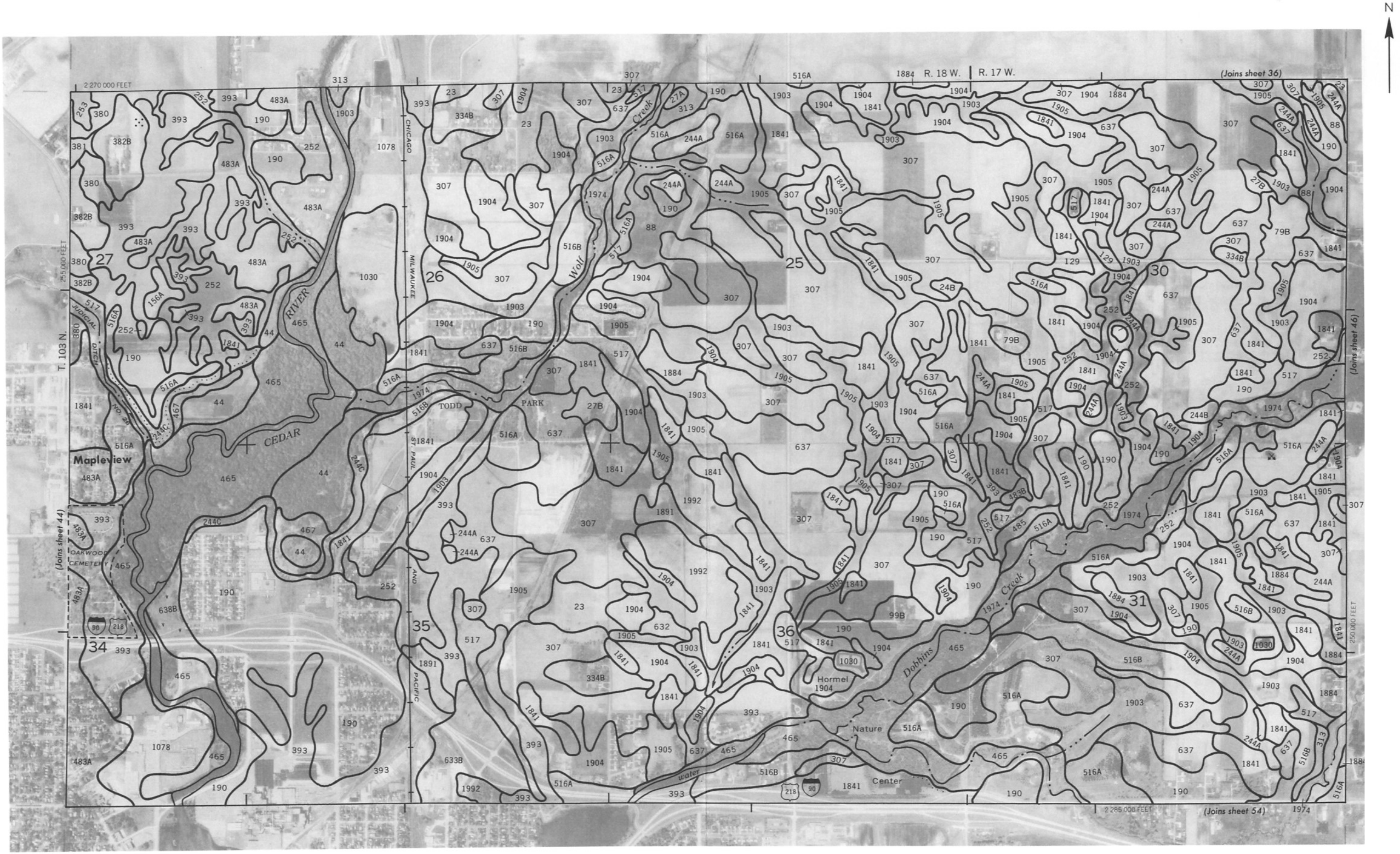
MOWER COUNTY, MINNESOTA — SHEET NUMBER 43

(43)

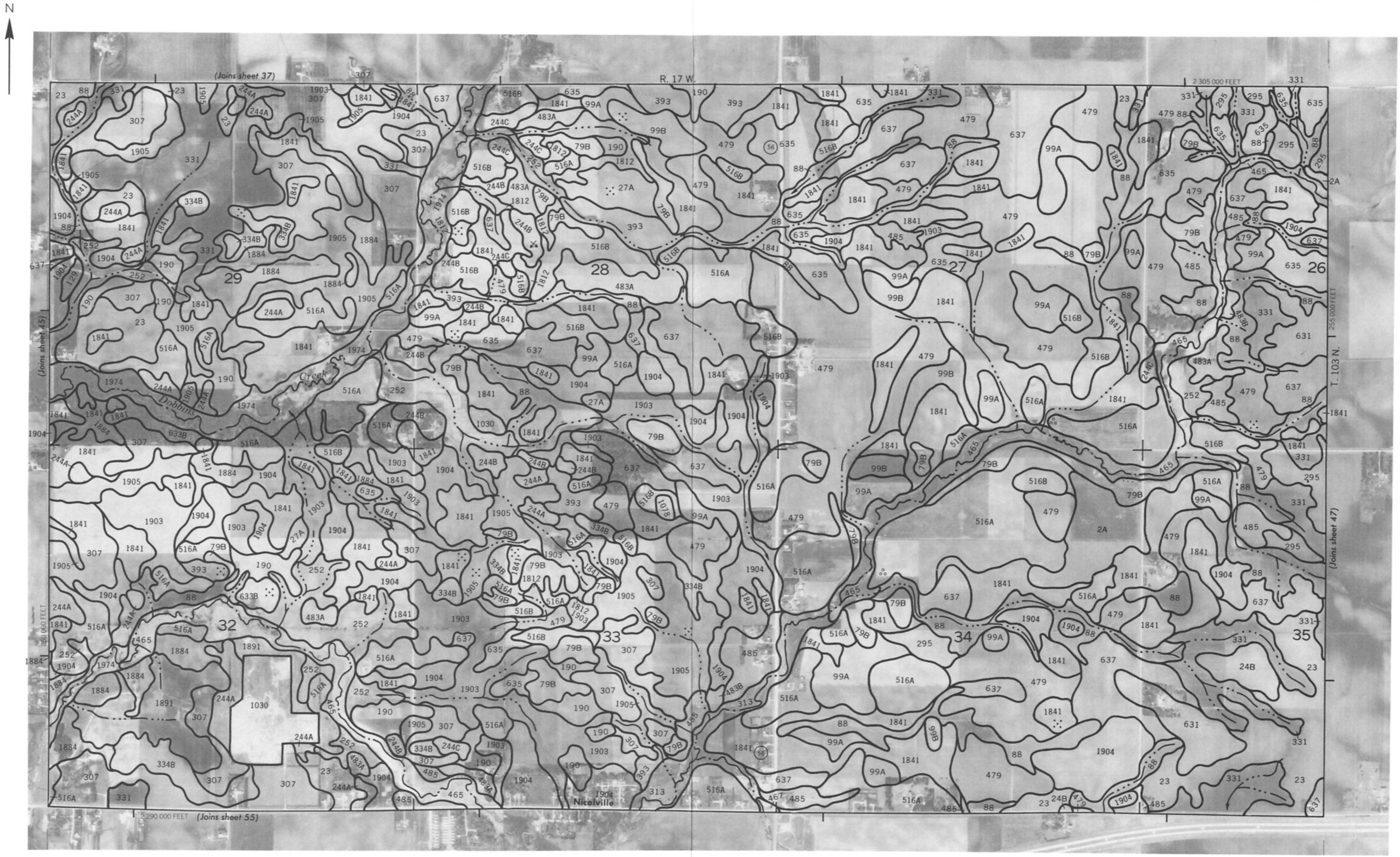

N
(Joins sheet 34)
R. 14 W.
2 400 000 FEET
270 000 FEET
T. 103 N.
(Joins sheet 42)
14
13
23
24
Deer Creek
FILLMORE COUNTY
63
16
(Joins sheet 52)
265 000 FEET
2 415 000 FEET


N
(Joins sheet 35)
R. 18 W.
2 265 000 FEET
Murphy
JUDICIAL
Creek
DITCH
NO. 26
218
27
255 000 FEET
T. 103 N.
Mapleview
(Joins sheet 45)
FREEBORN COUNTY
250 000 FEET
JUDICIAL
TURTLE
DITCH
NO. 1
CREEK
30
29
28
31
32
33
34
90
218
JUDICIAL
TURTLE
DITCH
CREEK
NO.
90
AUSTIN AREA VOCATIONAL TECHNICAL INSTITUTE
AUSTIN COMMUNITY COLLEGE
AUSTIN
(county seat)
(Joins sheet 53)
2 255 000 FEET

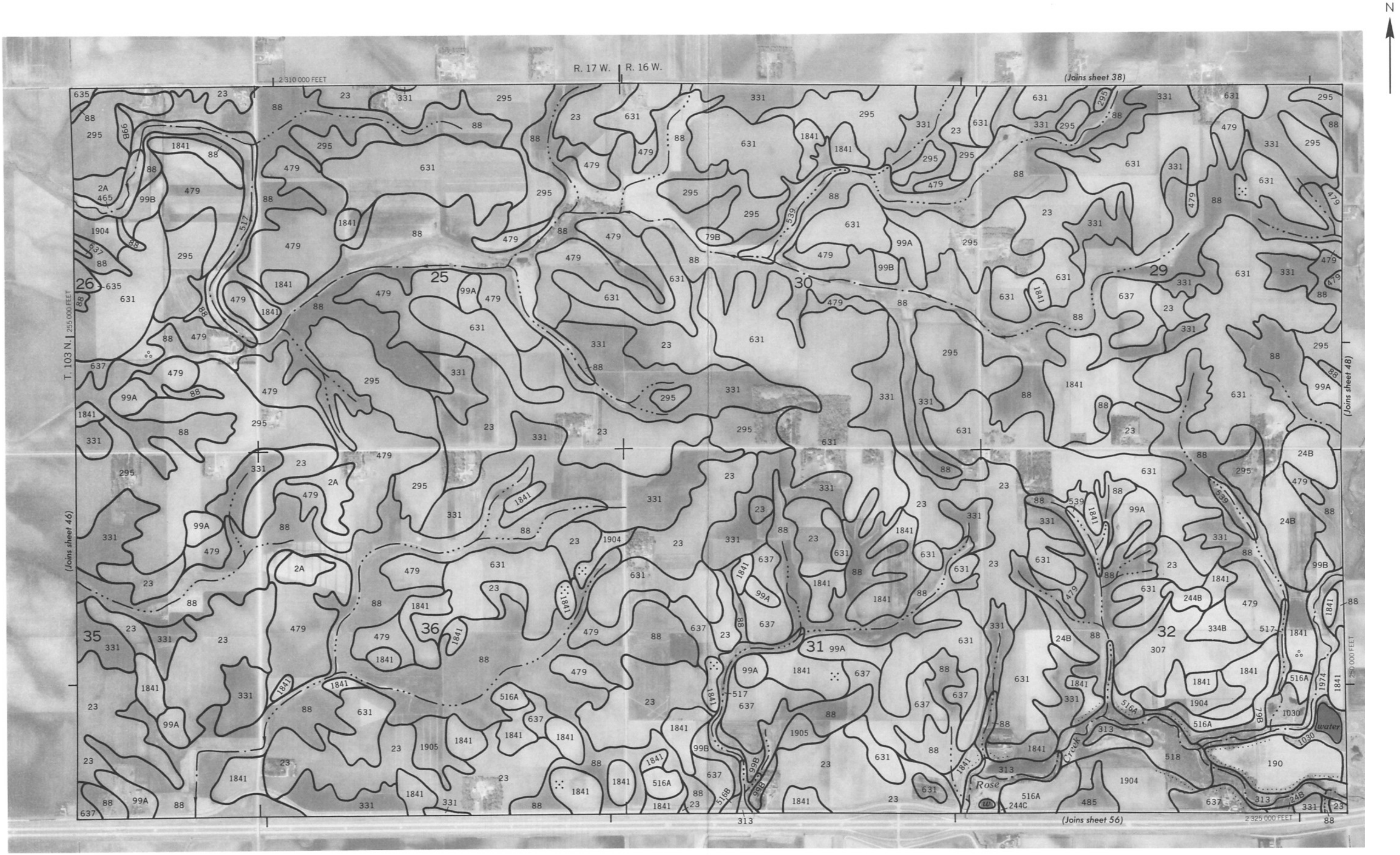
MOWER COUNTY, MINNESOTA — SHEET NUMBER 45


N
2 270 000 FEET
255 000 FEET
250 000 FEET
2 285 000 FEET
R. 18 W.
R. 17 W.
T. 103 N.
(Joins sheet 36)
(Joins sheet 46)
(Joins sheet 54)
(Joins sheet 44)
25
26
27
30
31
34
35
36
CEDAR
RIVER
Wolf
Creek
Dobbins
Creek
water
JUDICIAL
DITCH
NO. 26
CHICAGO
MILWAUKEE
ST. PAUL
AND
PACIFIC
TODD
PARK
Mapleview
OAKWOOD
CEMETERY
Hormel
Nature
Center
90
218

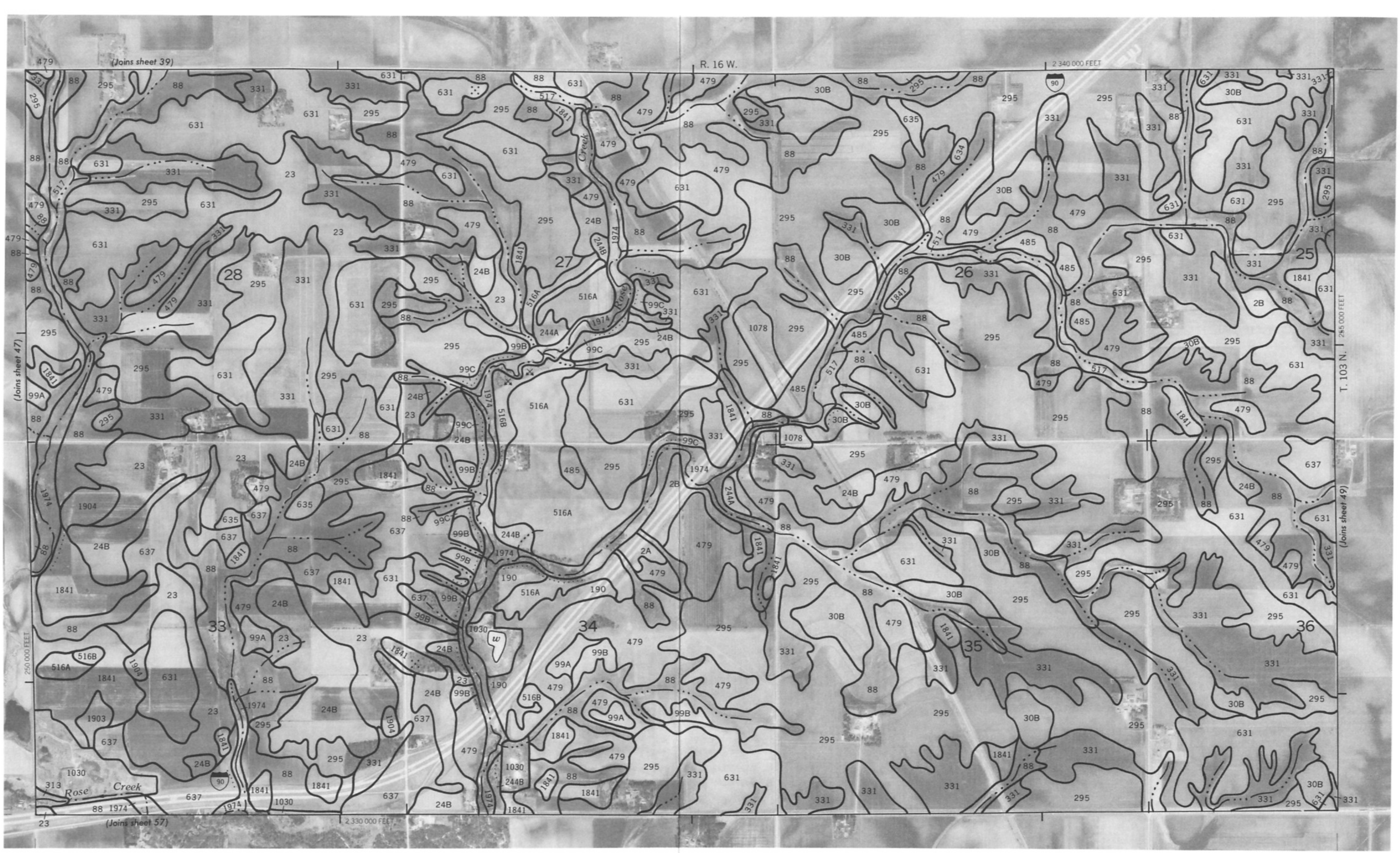
MOWER COUNTY, MINNESOTA — SHEET NUMBER 46


N
(Joins sheet 37)
R. 17 W.
2 305 000 FEET
(Joins sheet 45)
(Joins sheet 47)
T. 103 N.
255 000 FEET
250 000 FEET
2 290 000 FEET
(Joins sheet 55)
29
28
27
26
32
33
34
35
Dobbins
Creek
Nicolville
56

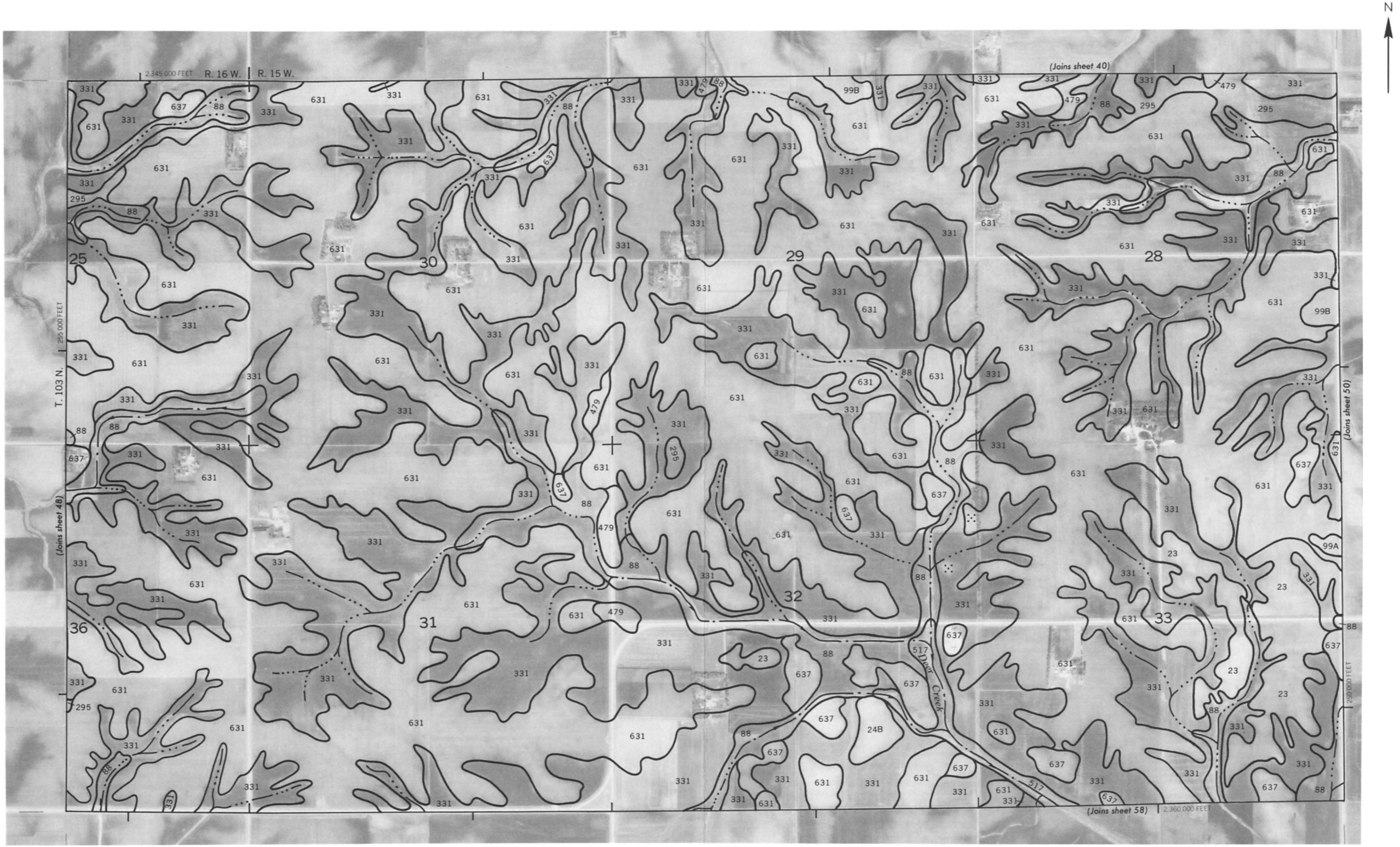
MOWER COUNTY, MINNESOTA — SHEET NUMBER 47


N
R. 17 W.
R. 16 W.
2 310 000 FEET
(Joins sheet 38)
T. 103 N.
255 000 FEET
(Joins sheet 46)
(Joins sheet 48)
250 000 FEET
(Joins sheet 56)
2 325 000 FEET
25
26
29
30
31
32
35
36
Rose
Creek
water
313
88

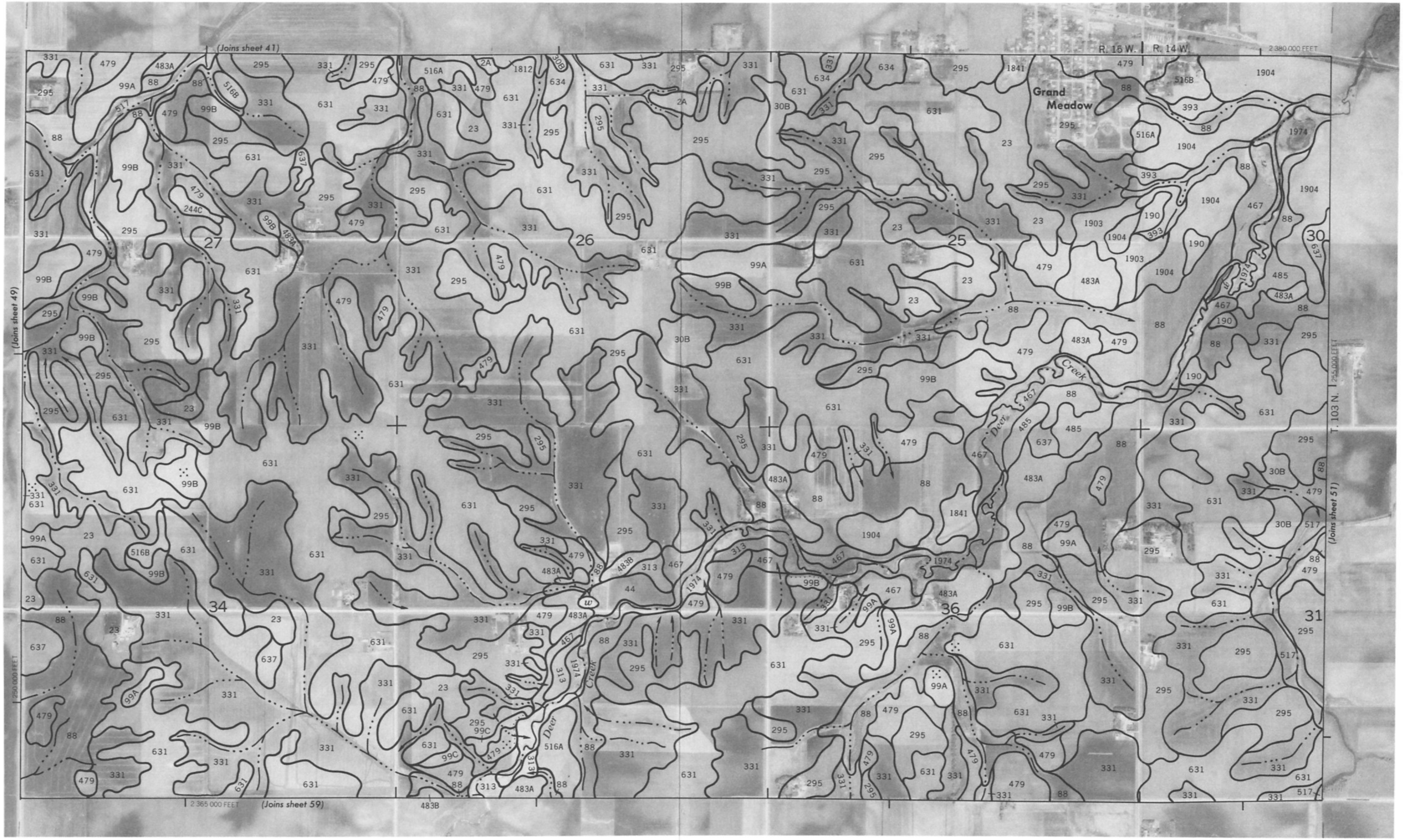
MOWER COUNTY, MINNESOTA — SHEET NUMBER 48


N
(Joins sheet 39)
R. 16 W.
2 340 000 FEET
(Joins sheet 47)
T. 103 N.
255 000 FEET
(Joins sheet 49)
250 000 FEET
(Joins sheet 57)
2 330 000 FEET
25
26
27
28
33
34
35
36
Rose Creek
Creek
Rose
90

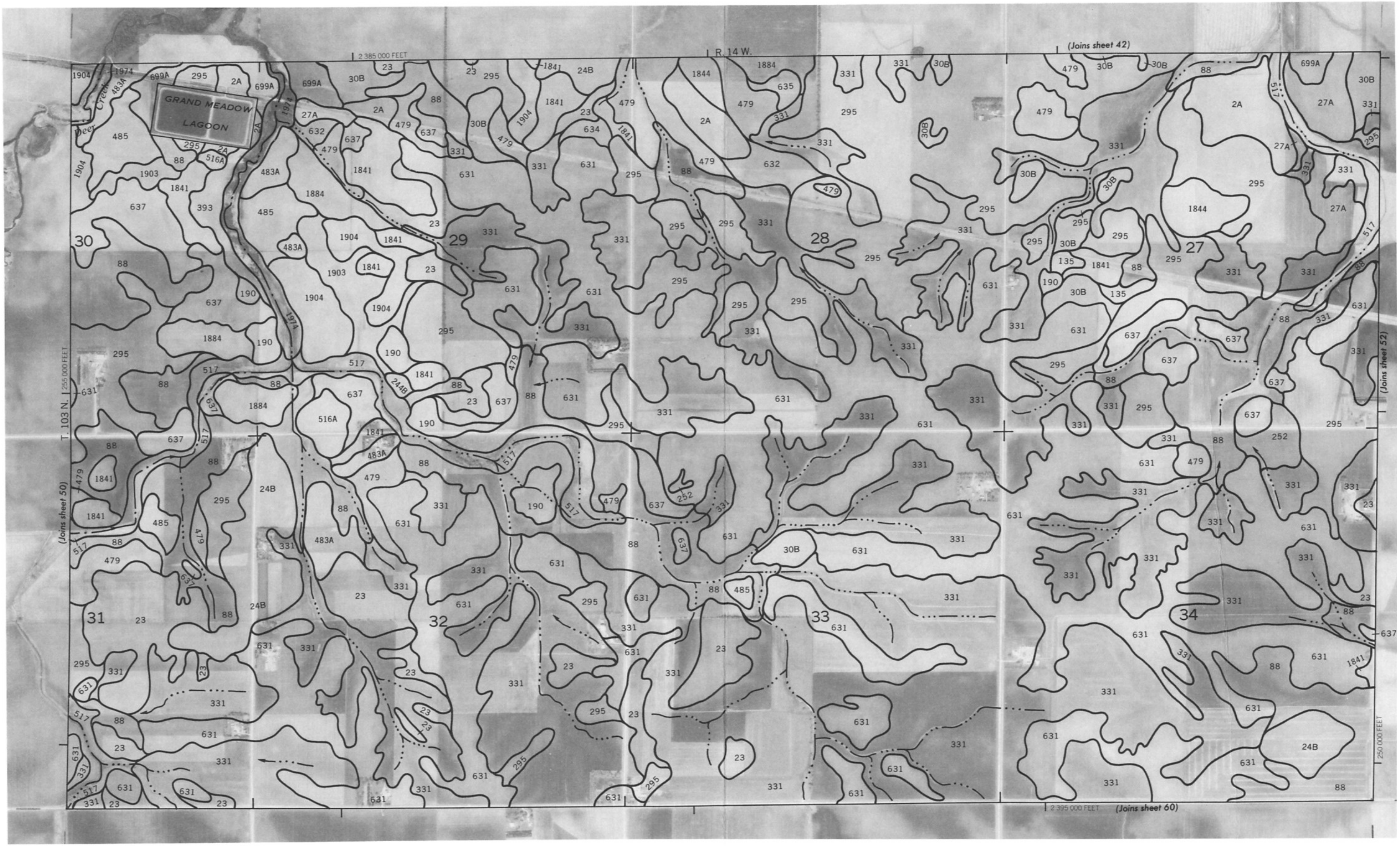
MOWER COUNTY, MINNESOTA — SHEET NUMBER 49


N
2 345 000 FEET
R. 16 W.
R. 15 W.
(Joins sheet 40)
(Joins sheet 50)
(Joins sheet 58)
(Joins sheet 48)
T. 103 N.
255 000 FEET
250 000 FEET
2 360 000 FEET
25
30
29
28
36
31
32
33
Deer Creek

N


(Joins sheet 41)
R. 15 W.
R. 14 W.
2 380 000 FEET
Grand Meadow
(Joins sheet 49)
(Joins sheet 51)
(Joins sheet 59)
2 365 000 FEET
250 000 FEET
T. 103 N.
27
26
25
30
34
36
31
Deer Creek
Deer
Creek
w
331
479
483A
295
631
516A
2A
1812
30B
634
1841
516B
1904
88
99A
99B
517
393
1974
23
637
244C
190
1903
485
467
483B
313
44
99C
2A

MOWER COUNTY, MINNESOTA — SHEET NUMBER 51

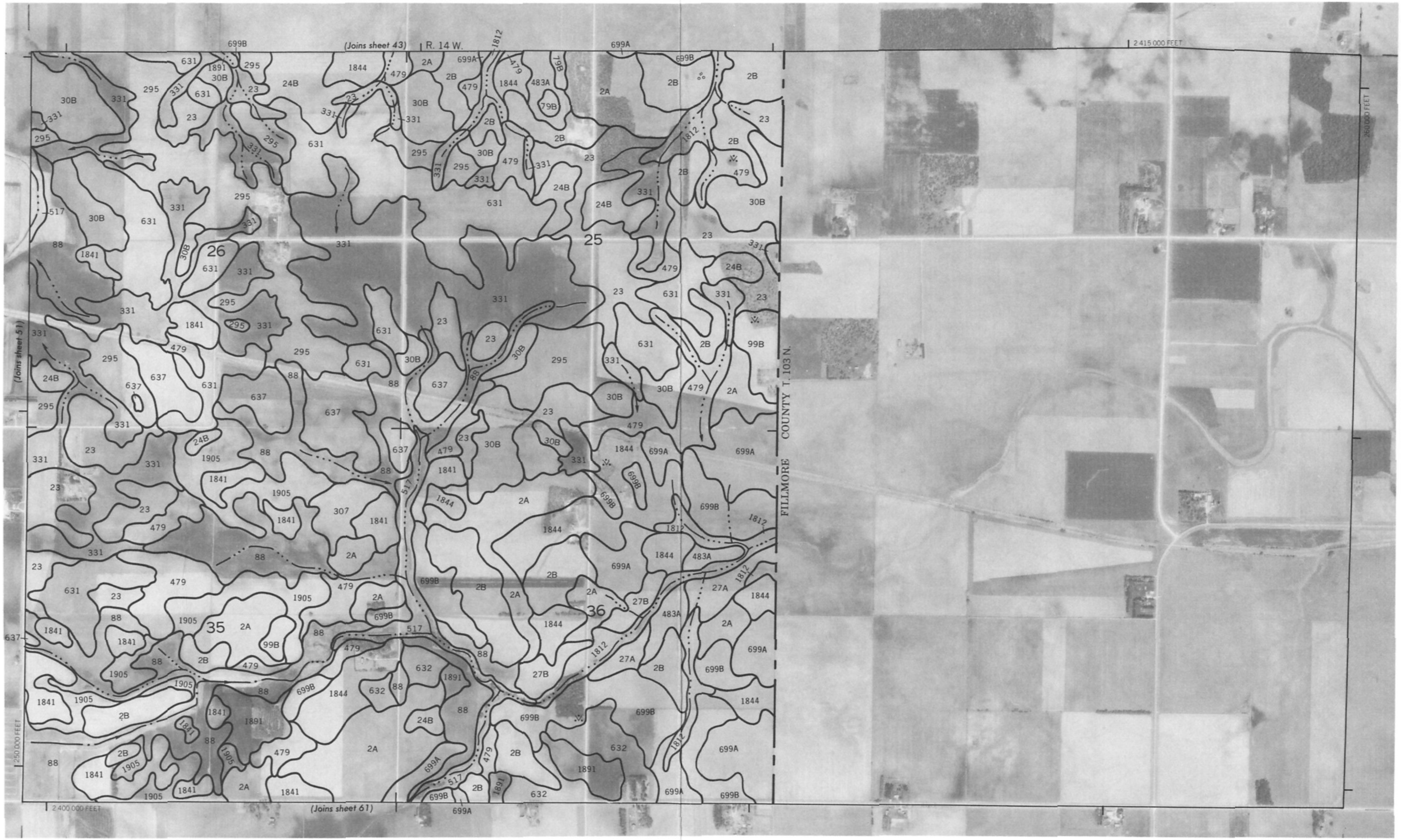


(51)
N
(Joins sheet 42)
R. 14 W.
2 385 000 FEET
GRAND MEADOW LAGOON
Deer Creek
T. 103 N.
255 000 FEET
(Joins sheet 50)
(Joins sheet 52)
250 000 FEET
2 395 000 FEET
(Joins sheet 60)
27
28
29
30
31
32
33
34

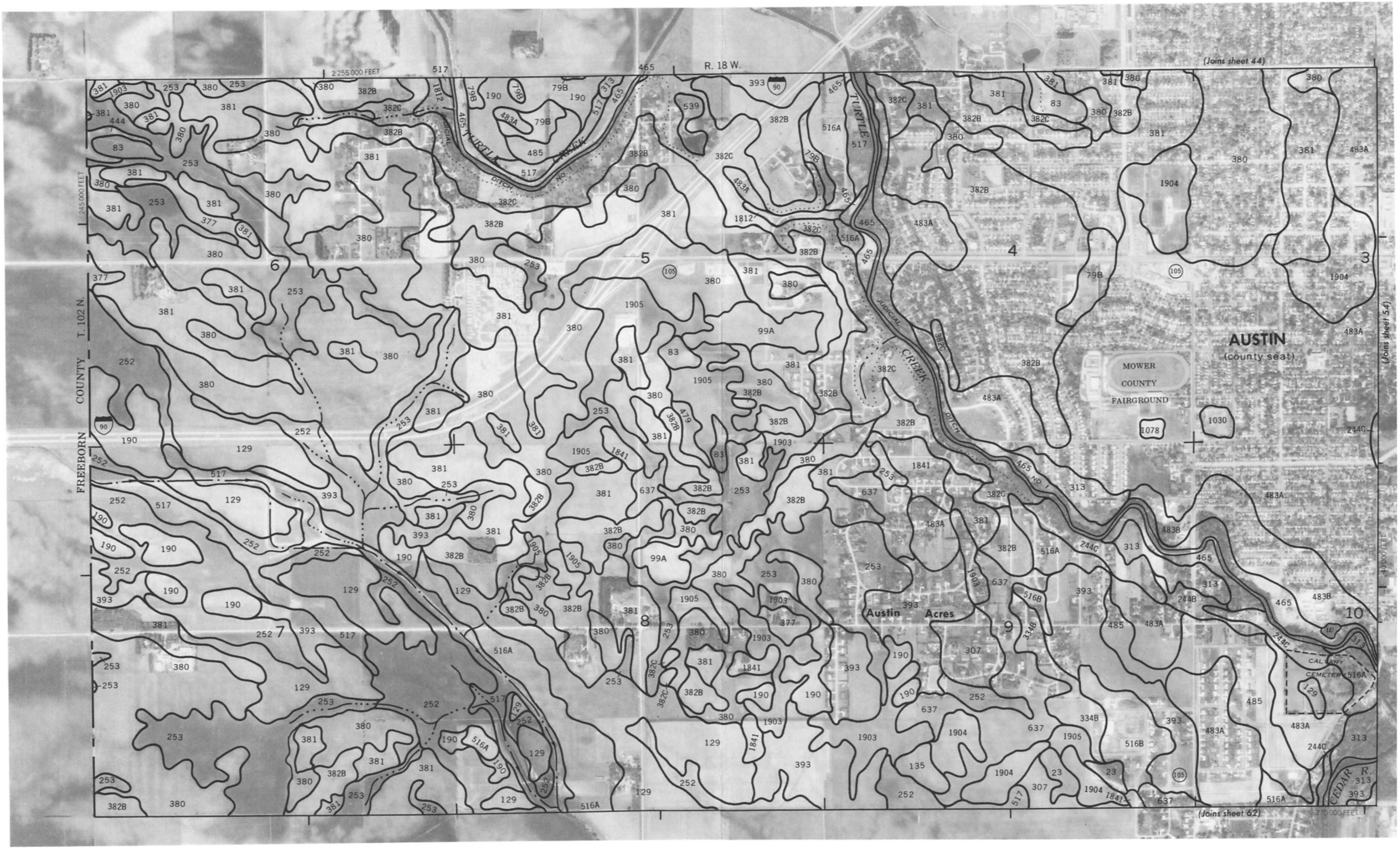
MOWER COUNTY, MINNESOTA — SHEET NUMBER 52

52

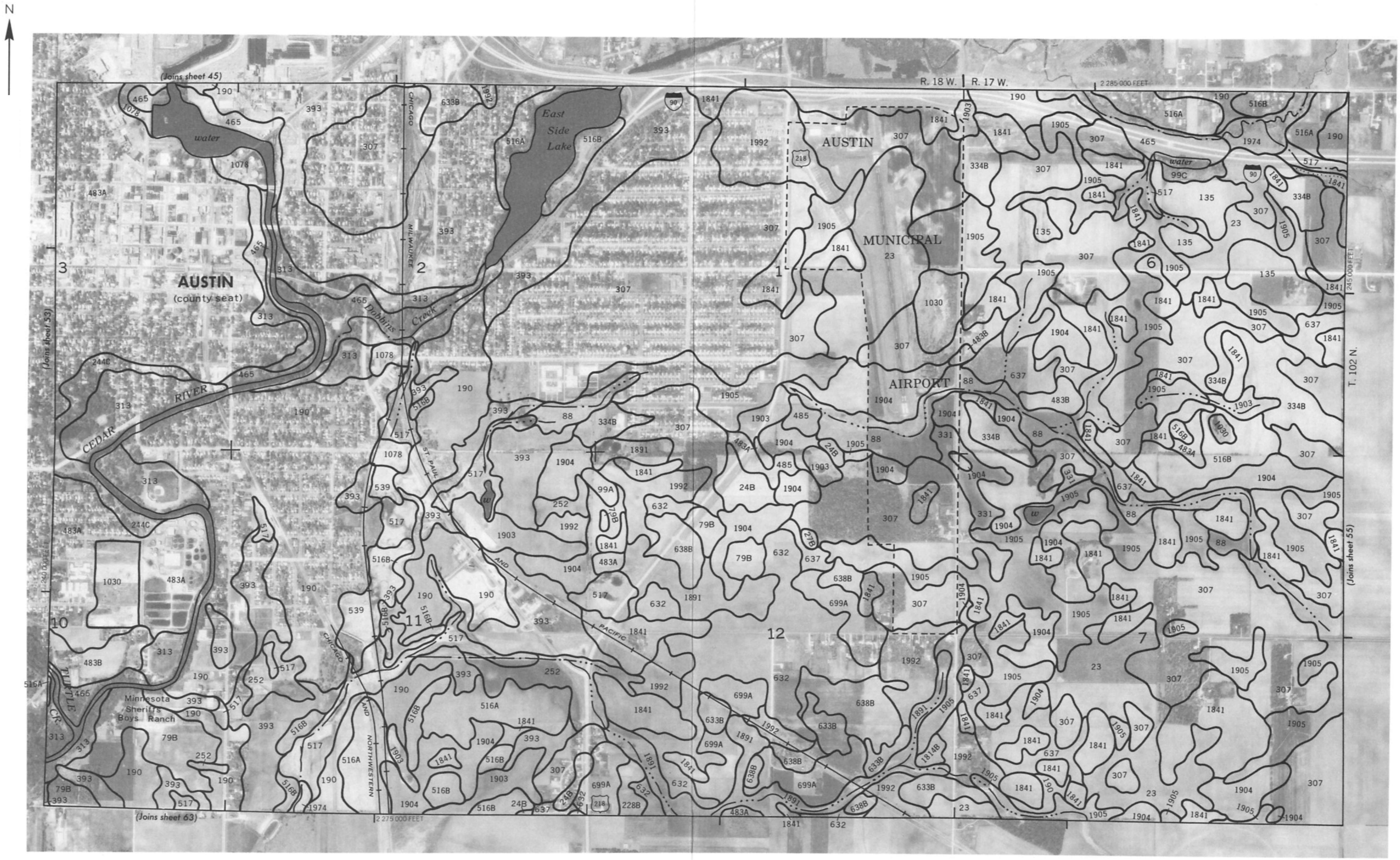
N


(Joins sheet 43)
R. 14 W.
2 415 000 FEET
260 000 FEET
(Joins sheet 51)
26
25
35
36
FILLMORE COUNTY T. 103 N.
250 000 FEET
2 400 000 FEET
(Joins sheet 61)

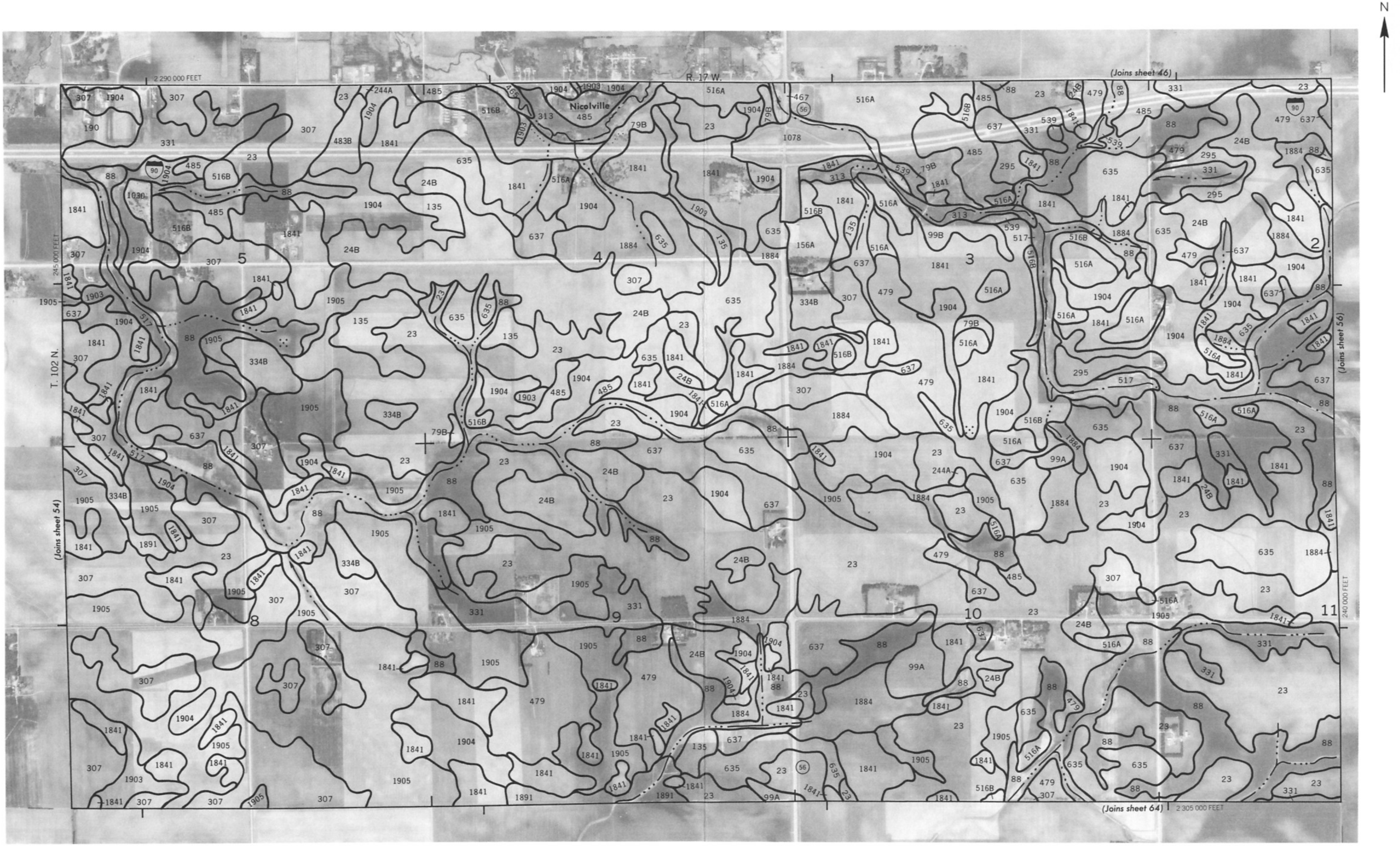
MOWER COUNTY, MINNESOTA — SHEET NUMBER 53


N
(Joins sheet 44)
(Joins sheet 54)
(Joins sheet 62)
R. 18 W.
T. 102 N.
FREEBORN COUNTY
2 255 000 FEET
245 000 FEET
240 000 FEET
2 270 000 FEET
AUSTIN
(county seat)
MOWER
COUNTY
FAIRGROUND
Austin Acres
CALVARY CEMETERY
TURTLE CREEK
JUDICIAL DITCH NO. 1
CEDAR R.
90
105
3
4
5
6
7
8
9
10
381
380
253
382B
382C
465
517
79B
190
483A
485
313
1812
539
516A
1904
1905
99A
83
129
252
393
637
1841
1903
1030
1078
244C
244B
483B
334B
516B
307
135
23
377
444
479

MOWER COUNTY, MINNESOTA — SHEET NUMBER 54

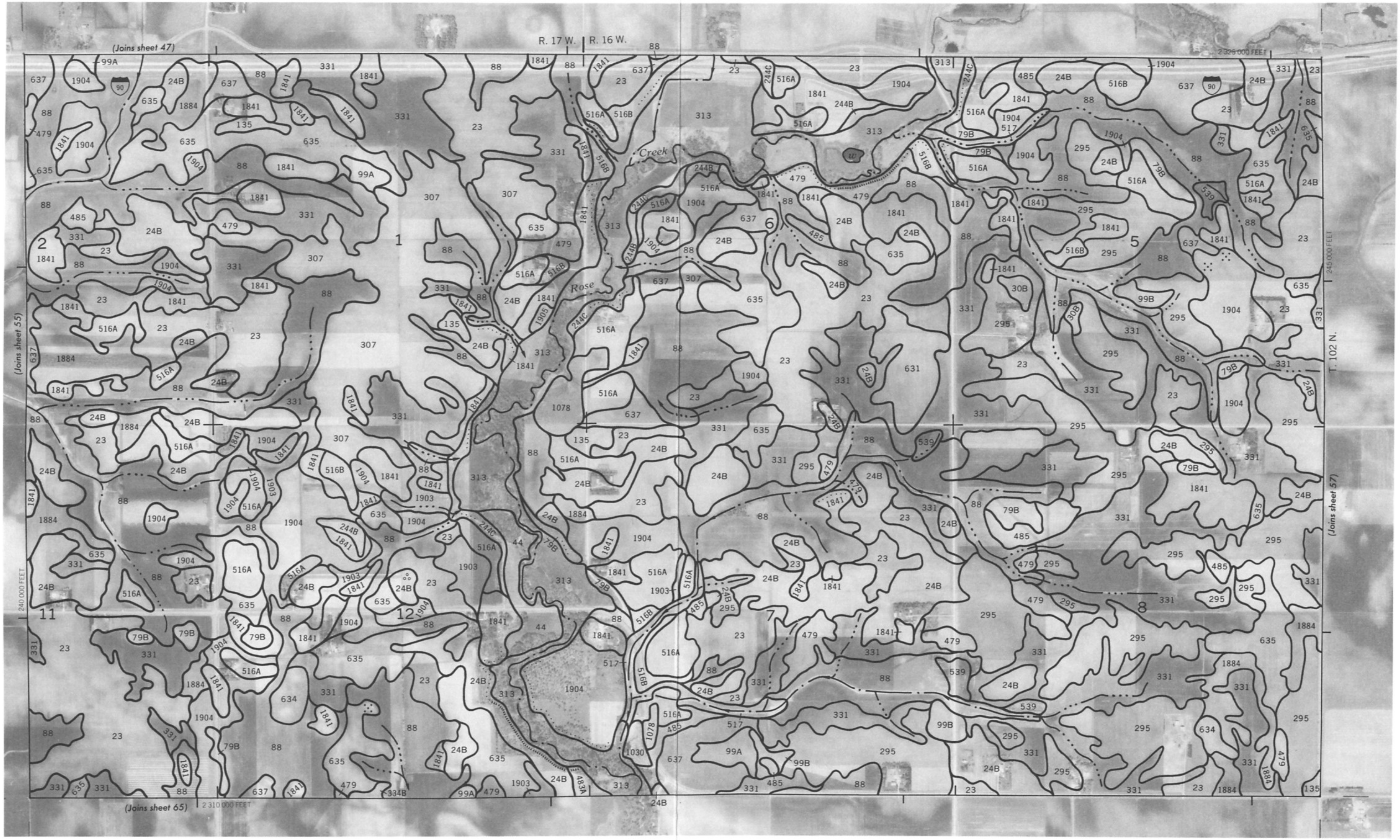

N
(Joins sheet 45)
(Joins sheet 53)
(Joins sheet 55)
(Joins sheet 63)
R. 18 W.
R. 17 W.
T. 102 N.
2 285 000 FEET
2 275 000 FEET
245 000 FEET
240 000 FEET
AUSTIN
(county seat)
AUSTIN
MUNICIPAL
AIRPORT
East
Side
Lake
water
CEDAR
RIVER
Dobbins
Creek
TURTLE
CR.
CHICAGO
MILWAUKEE
ST. PAUL
AND
PACIFIC
CHICAGO
AND
NORTHWESTERN
Minnesota
Sheriffs
Boys Ranch
90
218
1
2
3
6
7
10
11
12

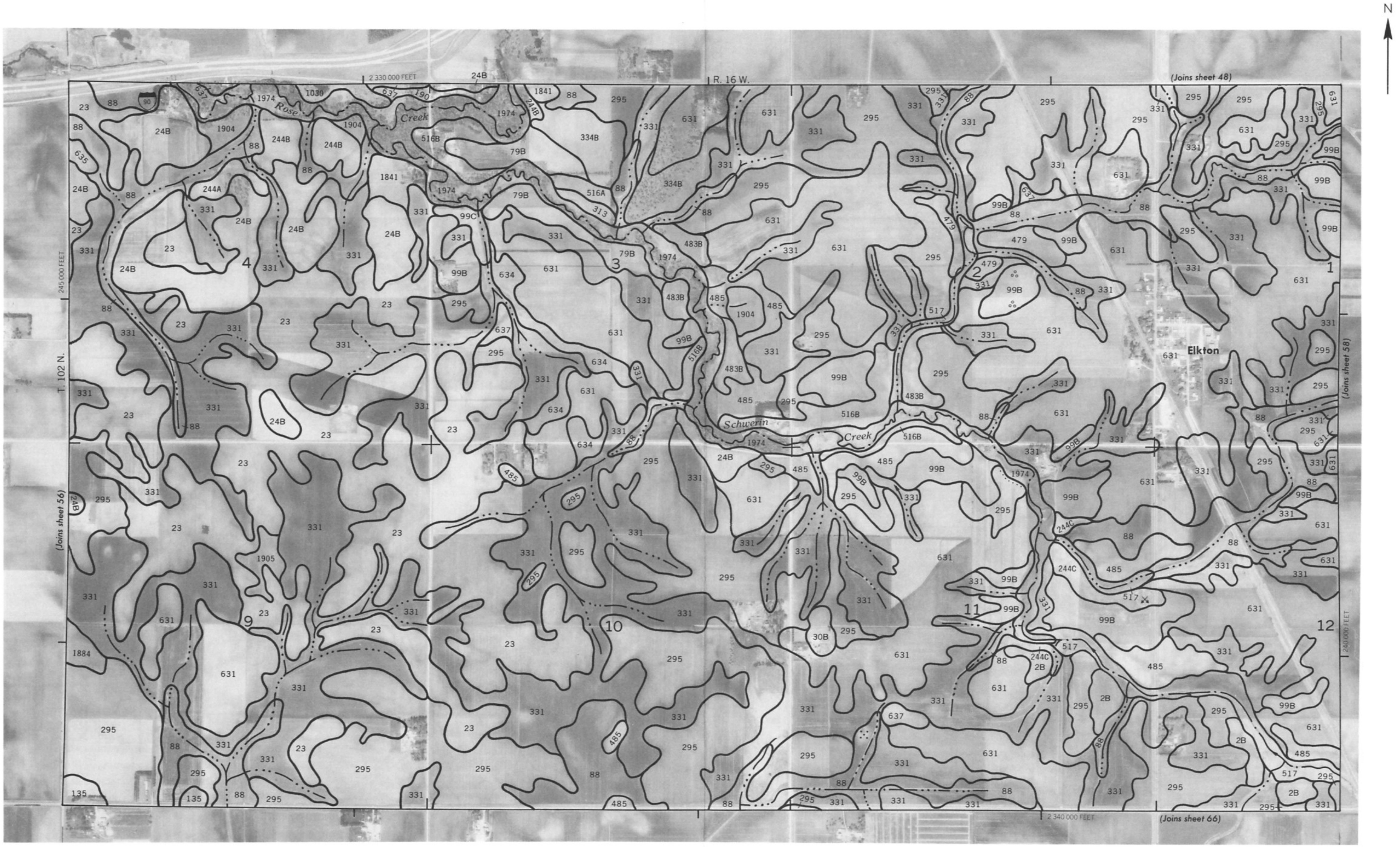
MOWER COUNTY, MINNESOTA — SHEET NUMBER 55


N
(Joins sheet 46)
2 290 000 FEET
R. 17 W.
Nicolville
90
56
245 000 FEET
T. 102 N.
(Joins sheet 54)
(Joins sheet 56)
240 000 FEET
(Joins sheet 64)
2 305 000 FEET
5
4
3
2
8
9
10
11

MOWER COUNTY, MINNESOTA — SHEET NUMBER 56

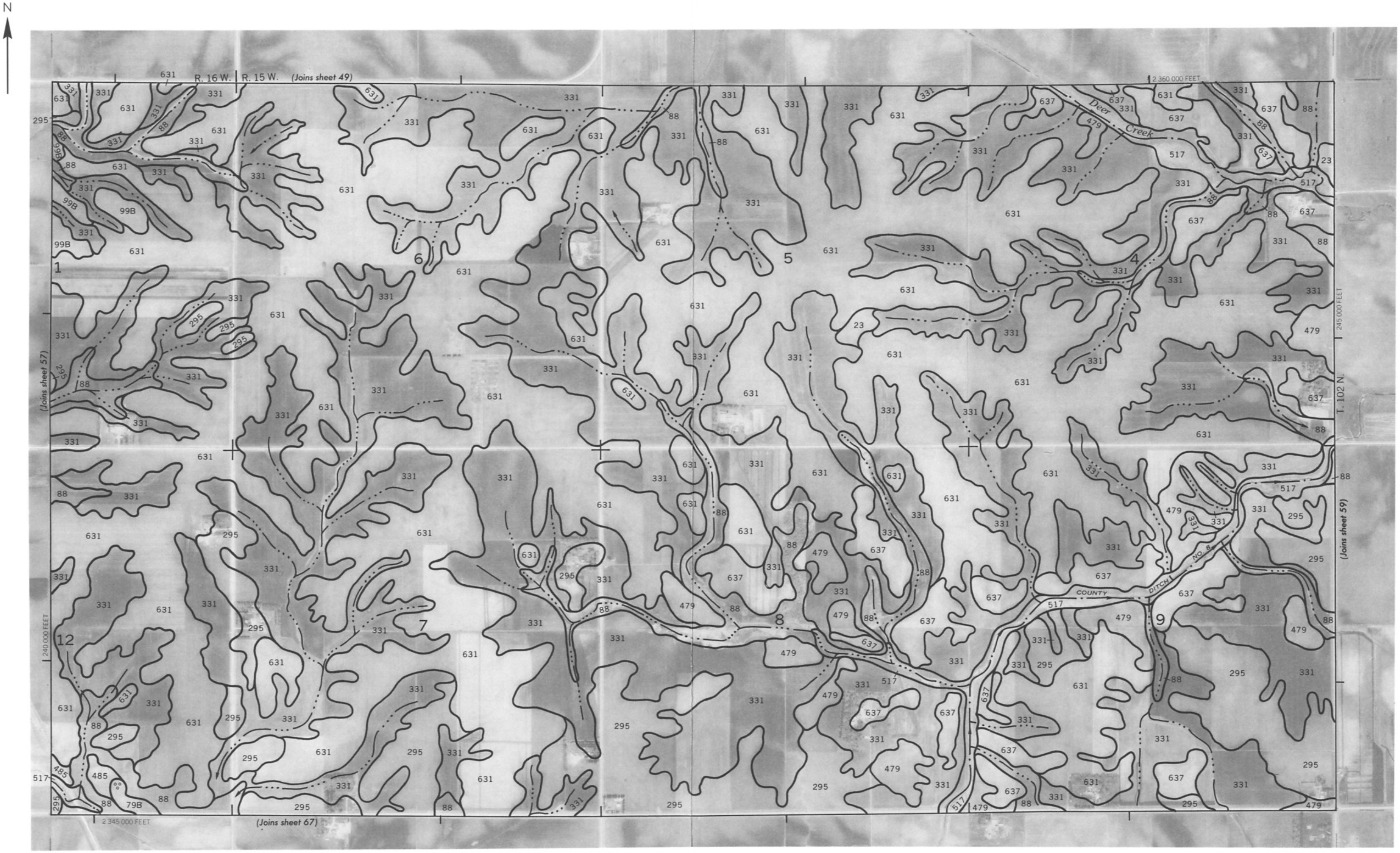
N


(Joins sheet 47)
R. 17 W.
R. 16 W.
2 325 000 FEET
(Joins sheet 55)
(Joins sheet 57)
(Joins sheet 65)
2 310 000 FEET
240 000 FEET
245 000 FEET
T. 102 N.
Rose
Creek
90
1
2
5
6
7
8
11
12

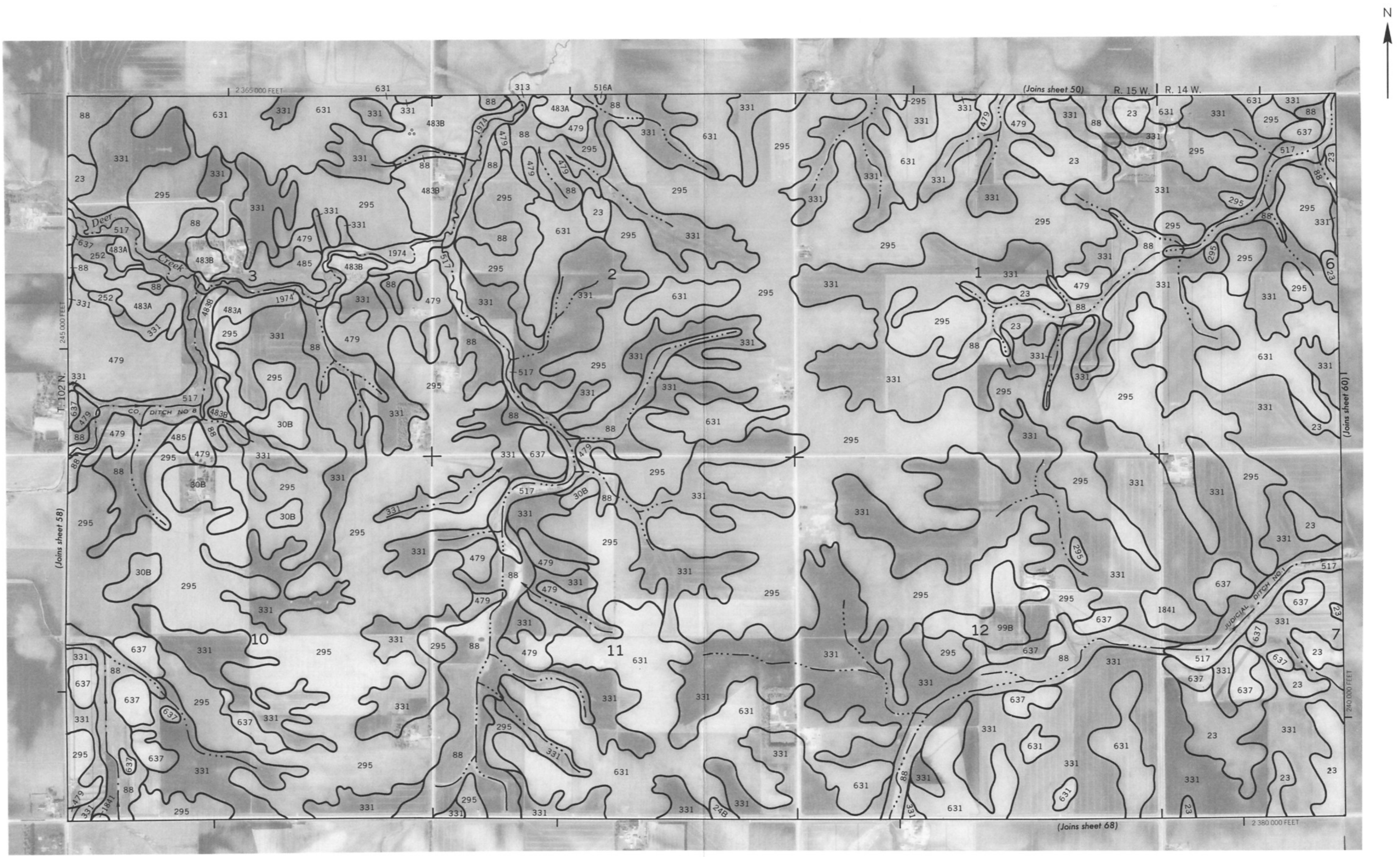

N
2 330 000 FEET
R. 16 W.
(Joins sheet 48)
90
Rose
Creek
Schwerin
Creek
Elkton
T. 102 N.
245 000 FEET
(Joins sheet 56)
(Joins sheet 58)
240 000 FEET
2 340 000 FEET
(Joins sheet 66)
1
2
3
4
9
10
11
12

㊽

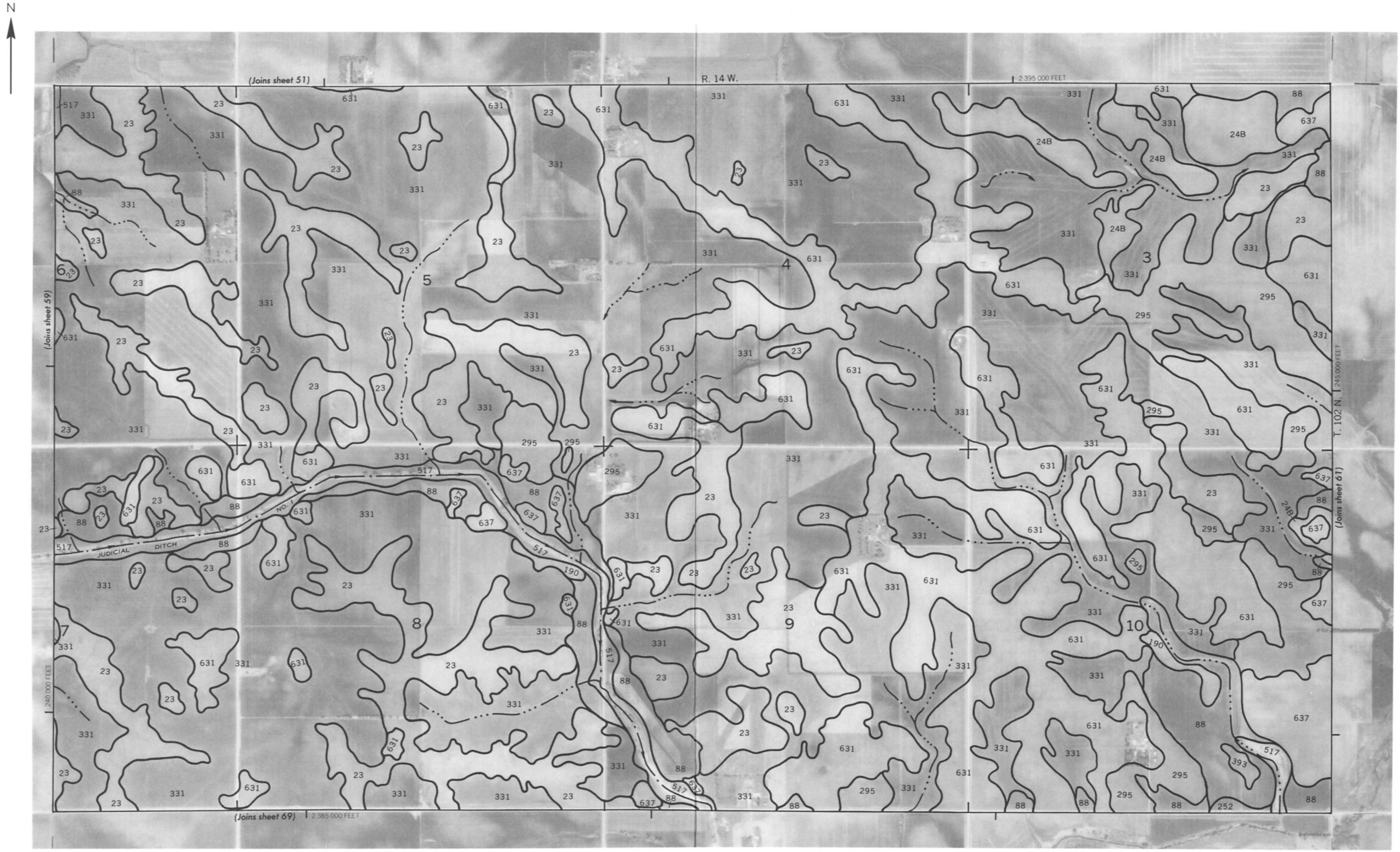
MOWER COUNTY, MINNESOTA — SHEET NUMBER 58


N
R. 16 W.
R. 15 W.
(Joins sheet 49)
(Joins sheet 57)
(Joins sheet 59)
(Joins sheet 67)
2 360 000 FEET
2 345 000 FEET
240 000 FEET
245 000 FEET
T. 102 N.
Deer Creek
COUNTY DITCH NO. 8
1
4
5
6
7
8
9
12
631
331
88
99B
295
637
479
517
23
485
79B

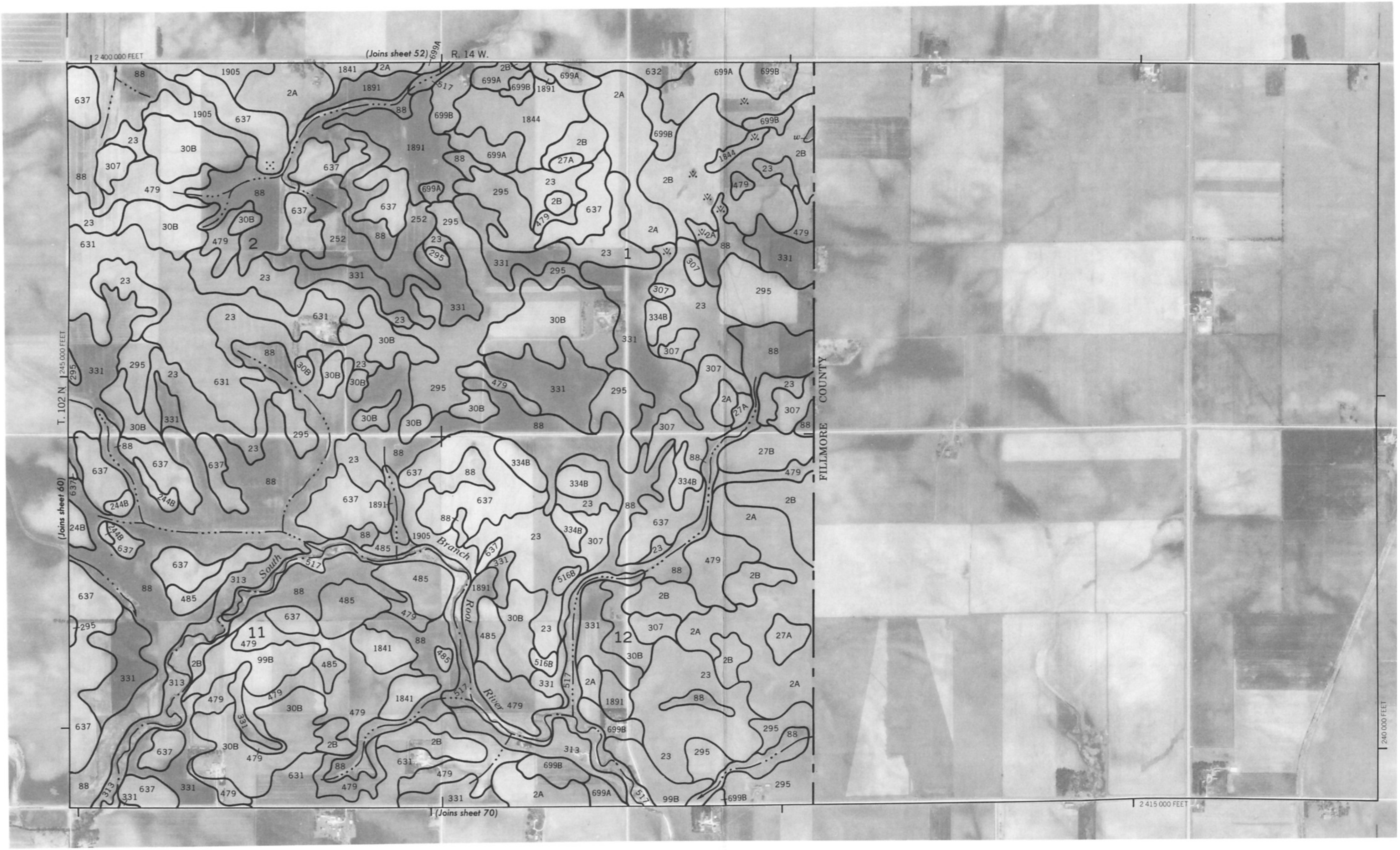
MOWER COUNTY, MINNESOTA — SHEET NUMBER 59


N
(Joins sheet 50)
R. 15 W.
R. 14 W.
2 365 000 FEET
245 000 FEET
T. 102 N.
(Joins sheet 58)
(Joins sheet 60)
240 000 FEET
(Joins sheet 68)
2 380 000 FEET
Deer Creek
CO. DITCH NO 8
JUDICIAL DITCH NO 1
1
2
3
6
7
10
11
12

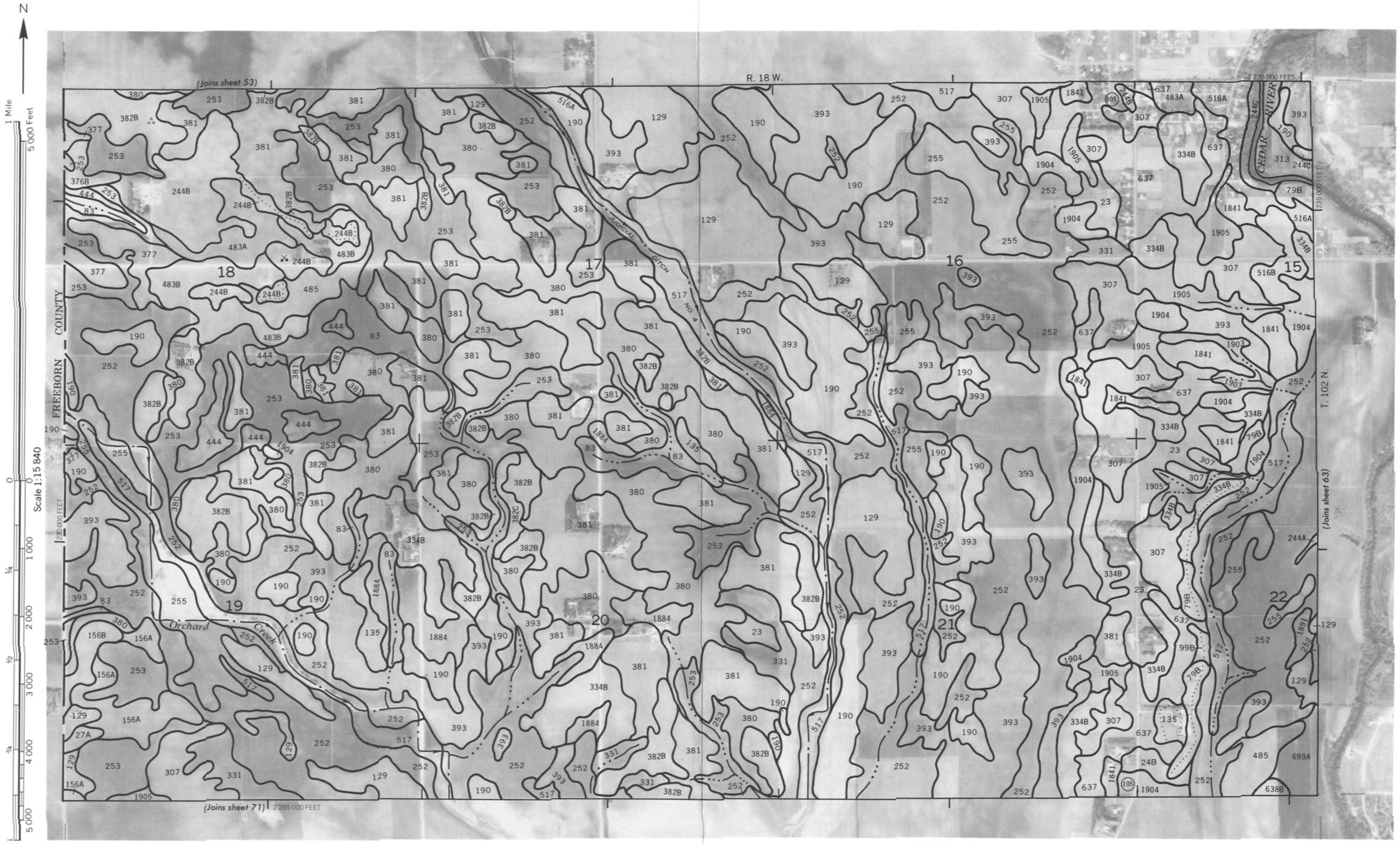
MOWER COUNTY, MINNESOTA — SHEET NUMBER 60


N
(Joins sheet 51)
R. 14 W.
2 395 000 FEET
(Joins sheet 59)
(Joins sheet 61)
T. 102 N.
245 000 FEET
240 000 FEET
(Joins sheet 69)
2 385 000 FEET
JUDICIAL DITCH NO. 1
3
4
5
6
7
8
9
10
23
24B
88
190
252
295
331
393
517
631
637

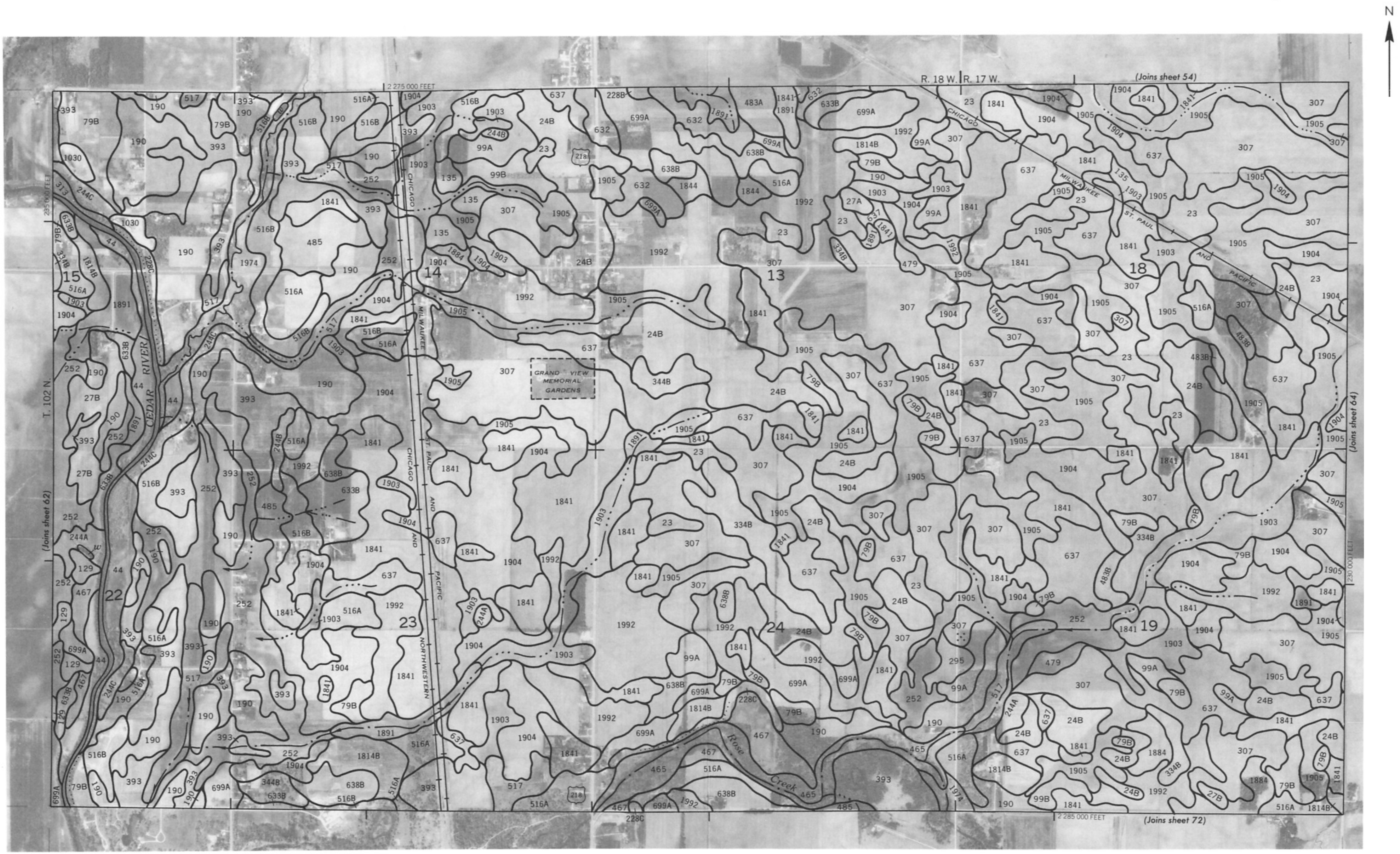
MOWER COUNTY, MINNESOTA — SHEET NUMBER 61


N
(Joins sheet 52)
R. 14 W.
2 400 000 FEET
245 000 FEET
T. 102 N
(Joins sheet 60)
(Joins sheet 70)
2 415 000 FEET
240 000 FEET
FILLMORE COUNTY
South Branch Root River
1
2
11
12

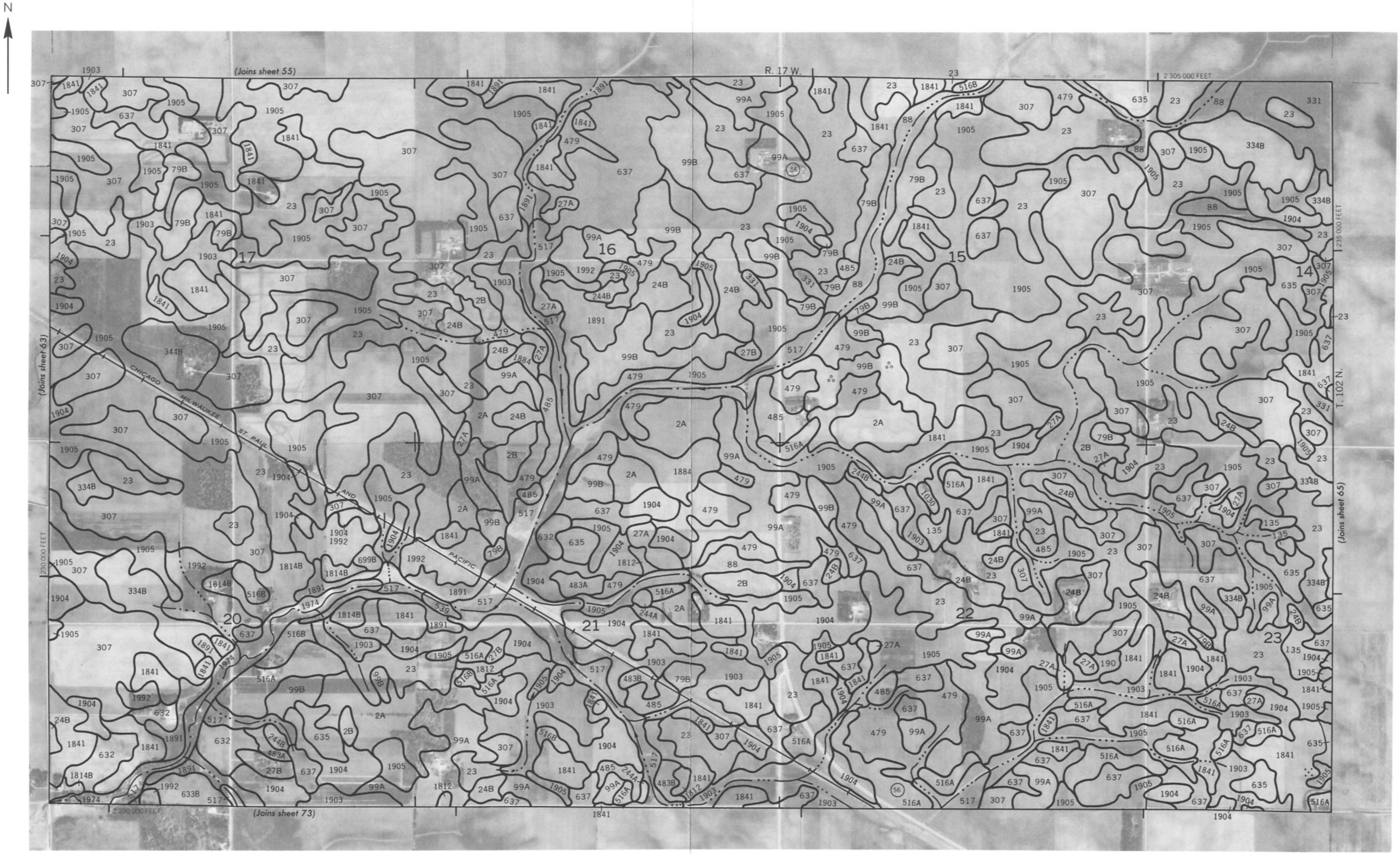
MOWER COUNTY, MINNESOTA — SHEET NUMBER 62


N
1 Mile
5 000 Feet
0
Scale 1:15 840
1 000
2 000
3 000
4 000
5 000
¼
½
¾
1
0
(Joins sheet 53)
R. 18 W.
2 270 000 FEET
235 000 FEET
230 000 FEET
T. 102 N.
(Joins sheet 63)
(Joins sheet 71)
2 255 000 FEET
FREEBORN COUNTY
CEDAR RIVER
JUDICIAL DITCH NO 4
Orchard Creek
15
16
17
18
19
20
21
22
105

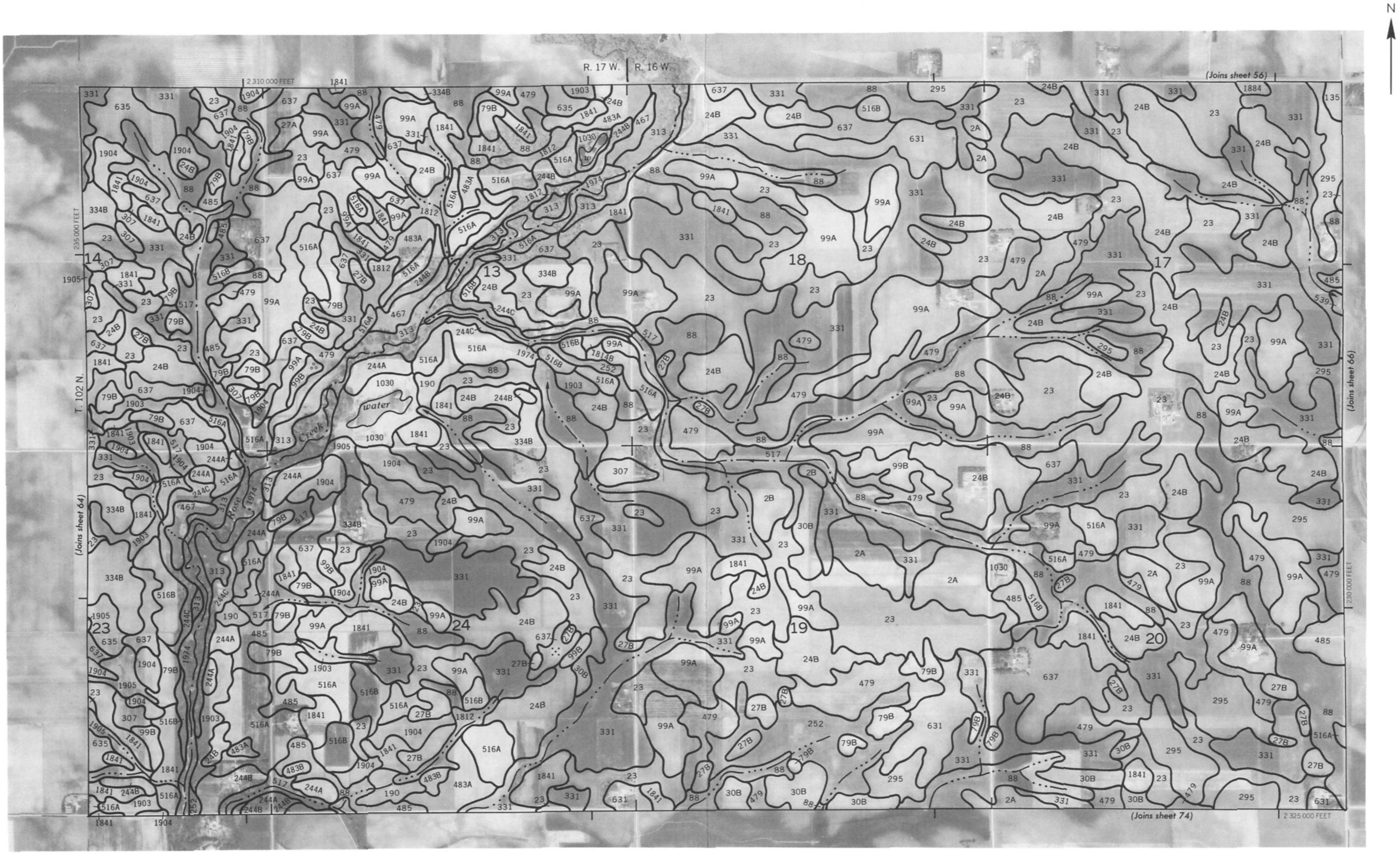
MOWER COUNTY, MINNESOTA — SHEET NUMBER 63


N
(Joins sheet 54)
(Joins sheet 62)
(Joins sheet 64)
(Joins sheet 72)
R. 18 W. | R. 17 W.
T. 102 N.
2 275 000 FEET
2 285 000 FEET
295 000 FEET
230 000 FEET
CEDAR RIVER
Rose Creek
CHICAGO MILWAUKEE ST. PAUL AND PACIFIC
CHICAGO AND NORTHWESTERN
GRAND VIEW MEMORIAL GARDENS
218
13
14
15
18
19
22
23
24

MOWER COUNTY, MINNESOTA — SHEET NUMBER 64

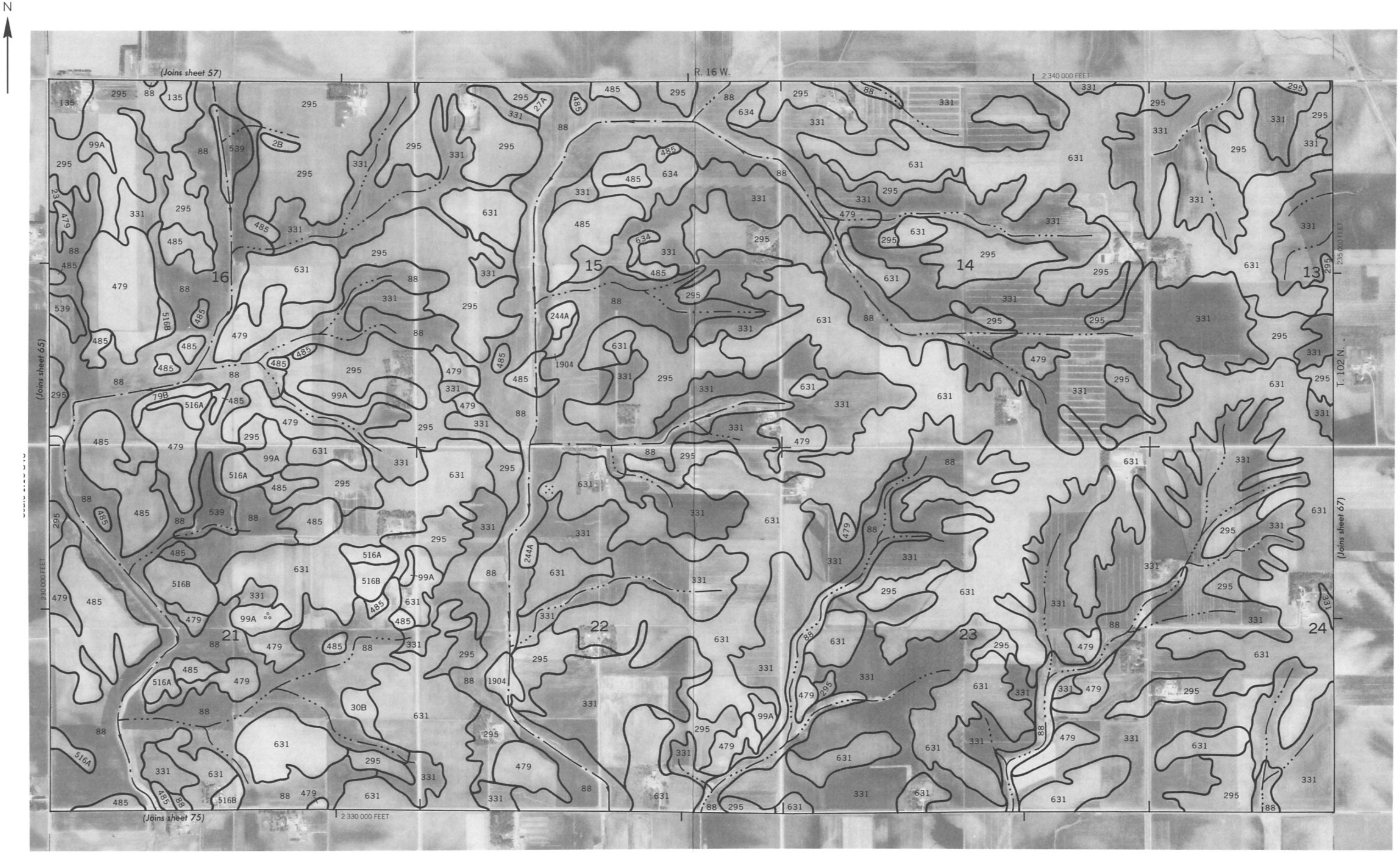

N
(Joins sheet 55)
R. 17 W.
2 305 000 FEET
235 000 FEET
T. 102 N.
(Joins sheet 65)
(Joins sheet 63)
230 000 FEET
2 290 000 FEET
(Joins sheet 73)
17
16
15
14
20
21
22
23
CHICAGO
MILWAUKEE
ST PAUL
AND
PACIFIC
56

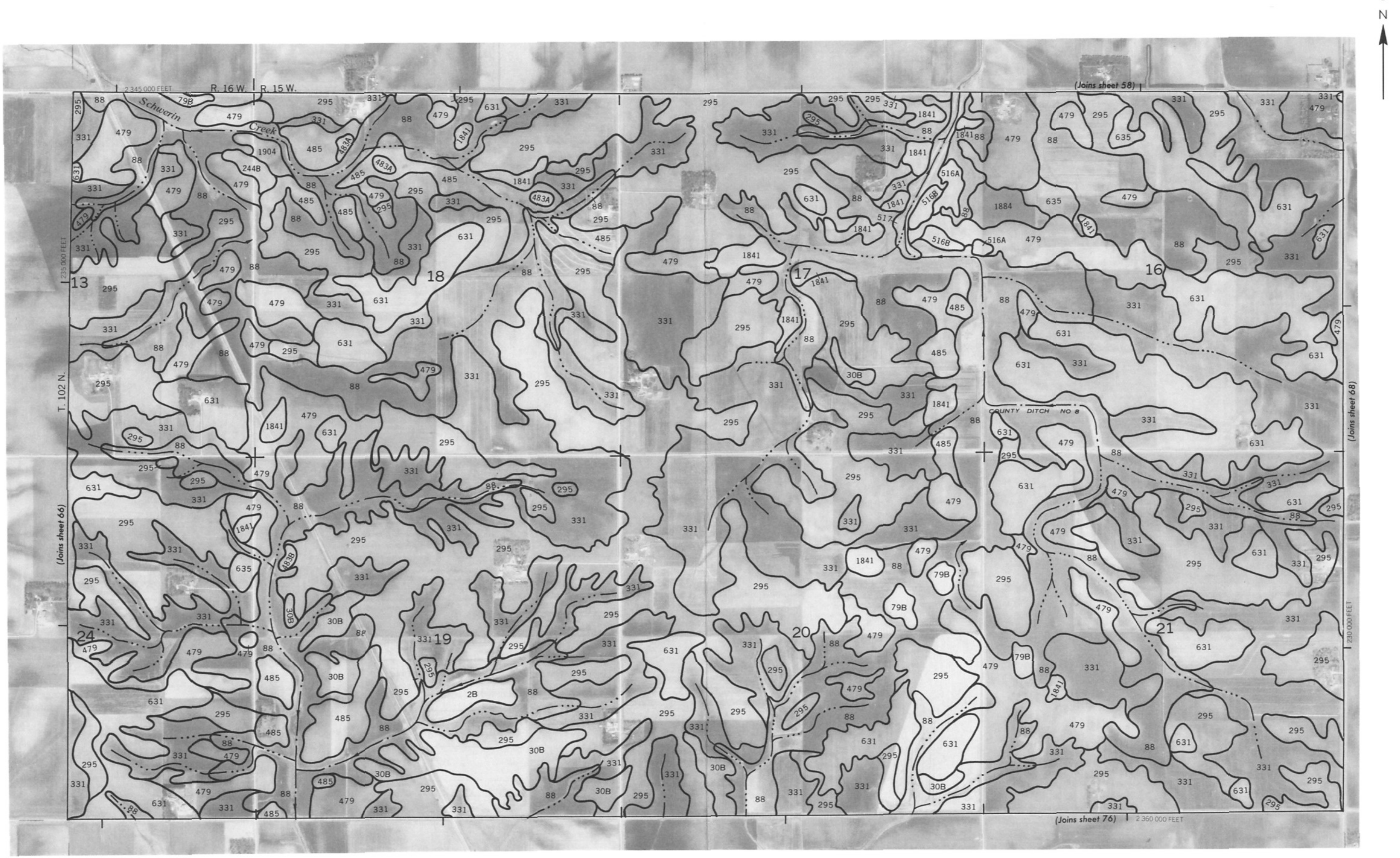
MOWER COUNTY, MINNESOTA — SHEET NUMBER 65

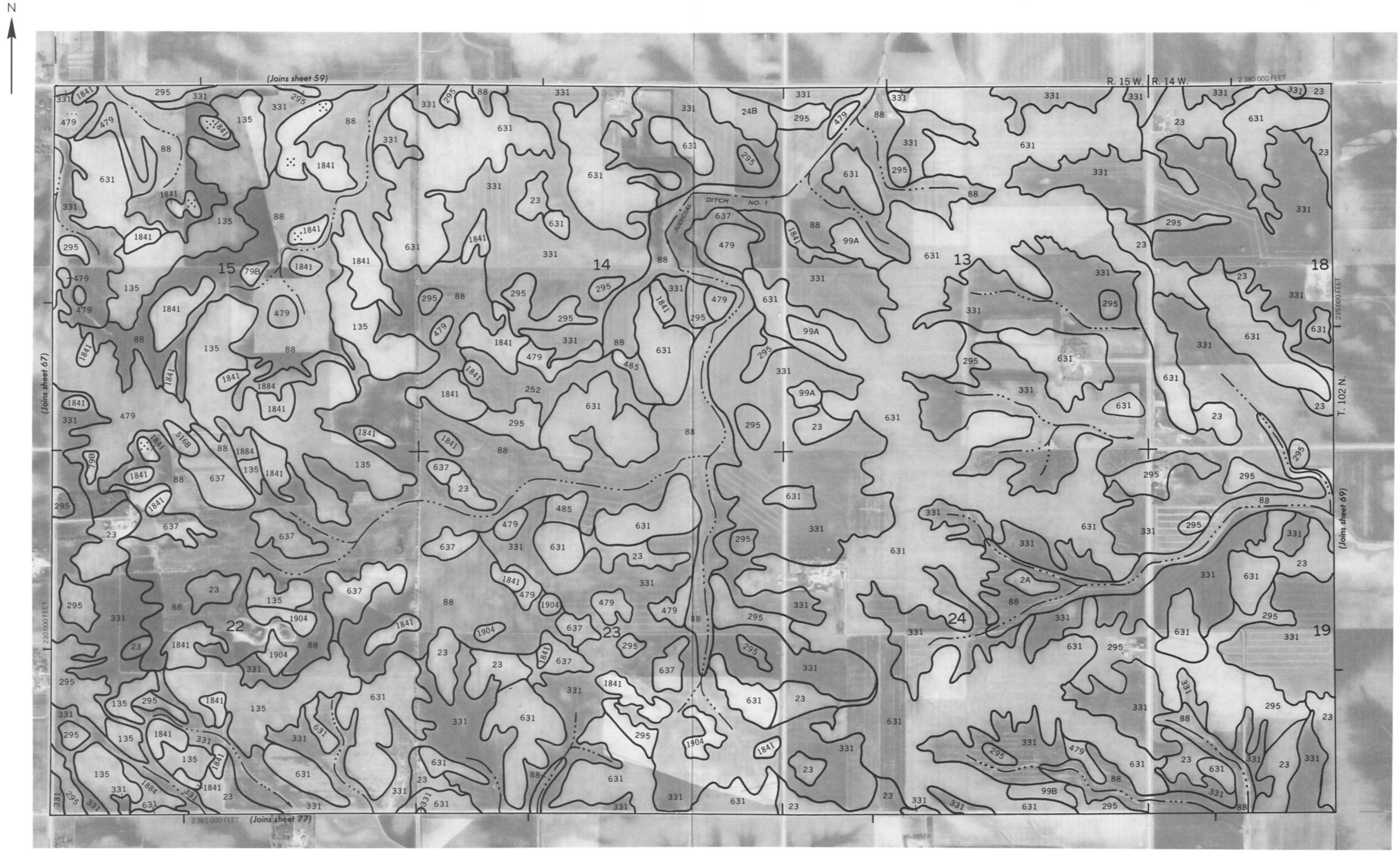

N
R. 17 W.
R. 16 W.
T. 102 N.
2 310 000 FEET
235 000 FEET
230 000 FEET
2 325 000 FEET
(Joins sheet 56)
(Joins sheet 64)
(Joins sheet 66)
(Joins sheet 74)
Rose Creek
water
14
13
18
17
23
24
19
20

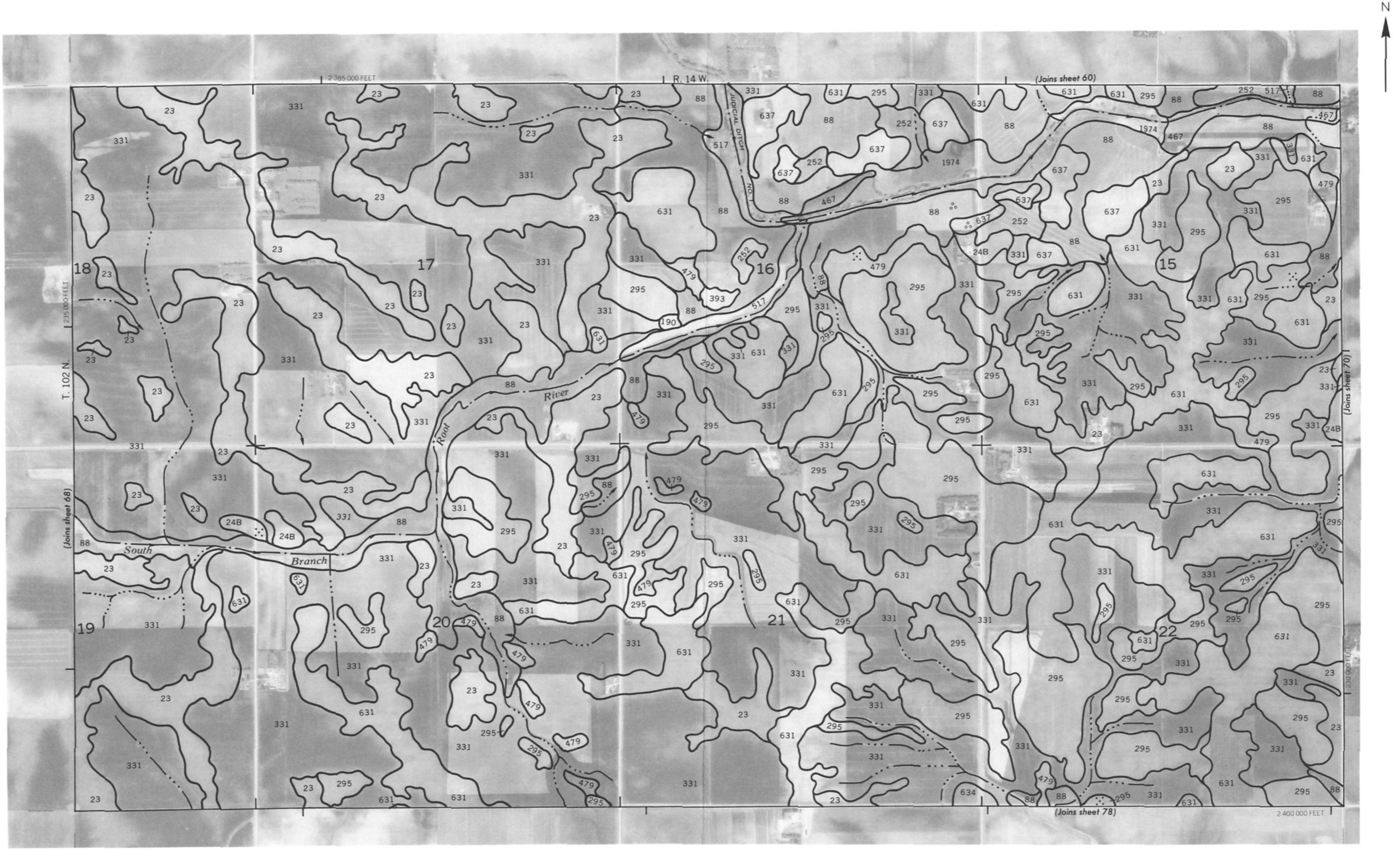
MOWER COUNTY, MINNESOTA — SHEET NUMBER 66

⑥⑥

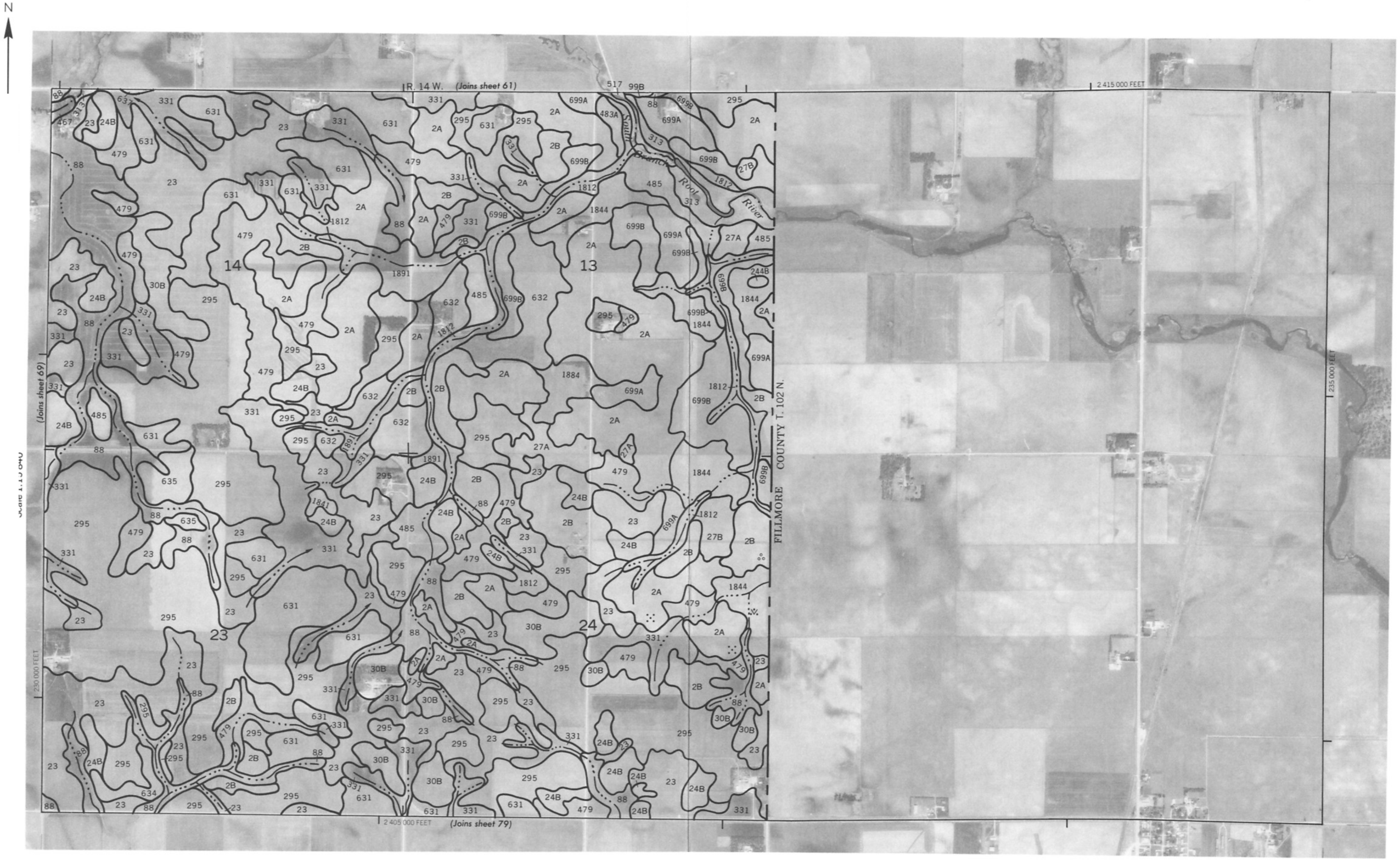

N
(Joins sheet 57)
R. 16 W.
2 340 000 FEET
(Joins sheet 65)
(Joins sheet 67)
235 000 FEET
T. 102 N.
230 000 FEET
(Joins sheet 75)
2 330 000 FEET
16
15
14
13
21
22
23
24

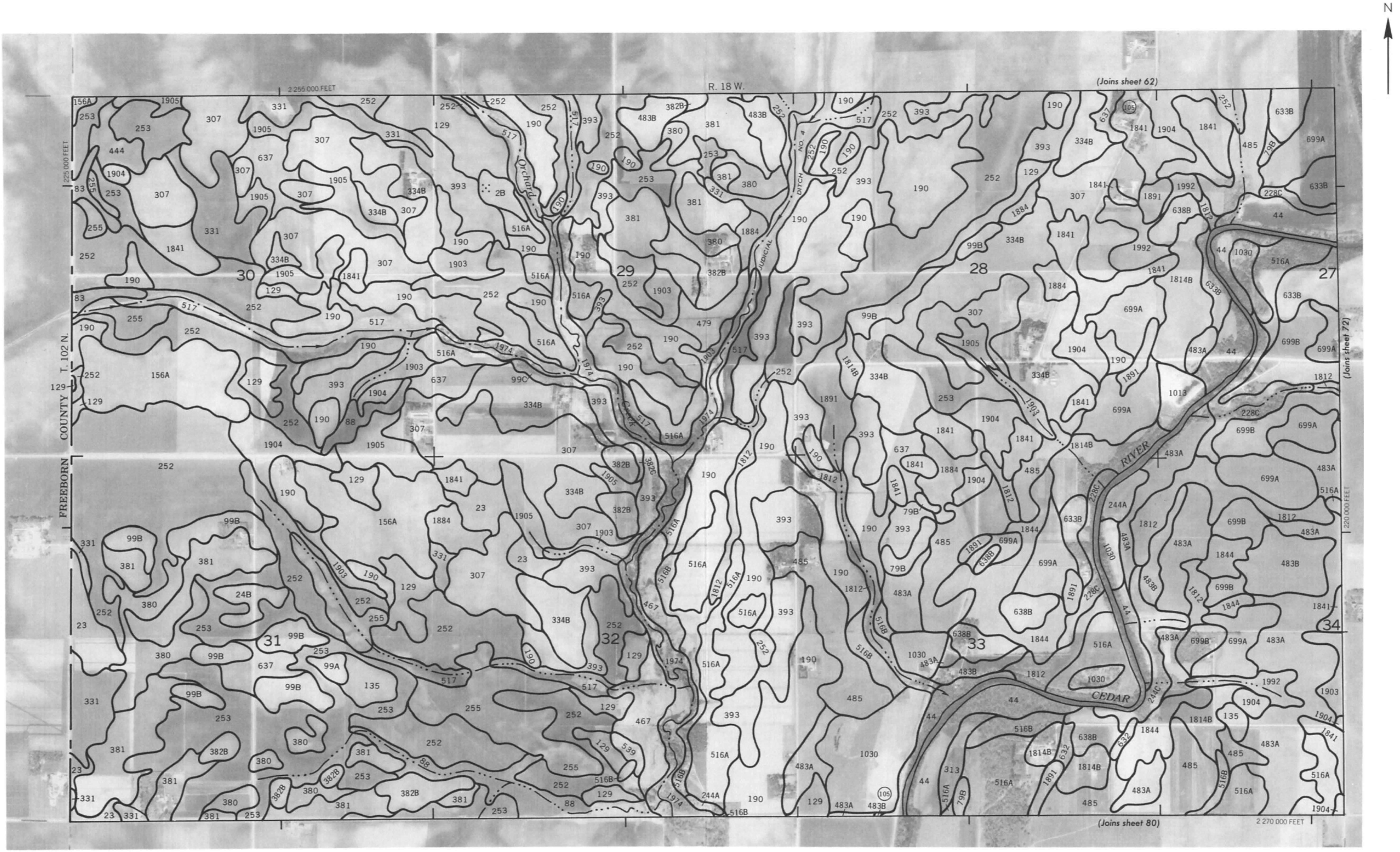

N
R. 16 W.
R. 15 W.
2 345 000 FEET
(Joins sheet 58)
(Joins sheet 66)
(Joins sheet 68)
(Joins sheet 76)
2 360 000 FEET
235 000 FEET
230 000 FEET
T. 102 N.
Schwerin Creek
COUNTY DITCH NO 8
13
16
17
18
19
20
21
24

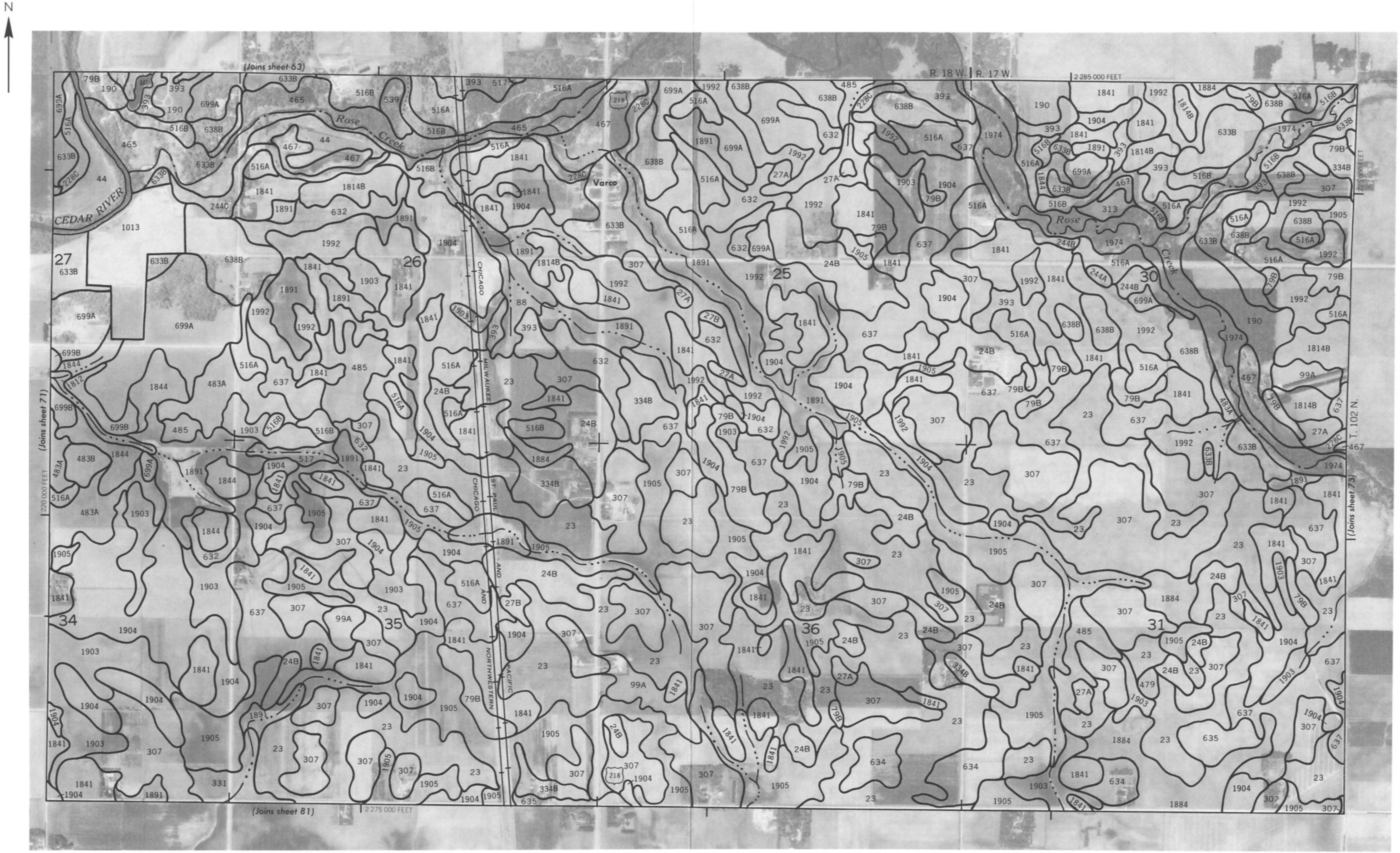

N
(Joins sheet 59)
(Joins sheet 67)
(Joins sheet 69)
(Joins sheet 77)
R. 15 W.
R. 14 W.
T. 102 N.
2 380 000 FEET
235 000 FEET
230 000 FEET
2 365 000 FEET
JUDICIAL DITCH NO. 1
15
14
13
18
22
23
24
19


N
(Joins sheet 60)
(Joins sheet 68)
(Joins sheet 70)
(Joins sheet 78)
R. 14 W.
T. 102 N.
2 385 000 FEET
2 400 000 FEET
235 000 FEET
230 000 FEET
Root River
South Branch
JUDICIAL DITCH NO. 1
15
16
17
18
19
20
21
22

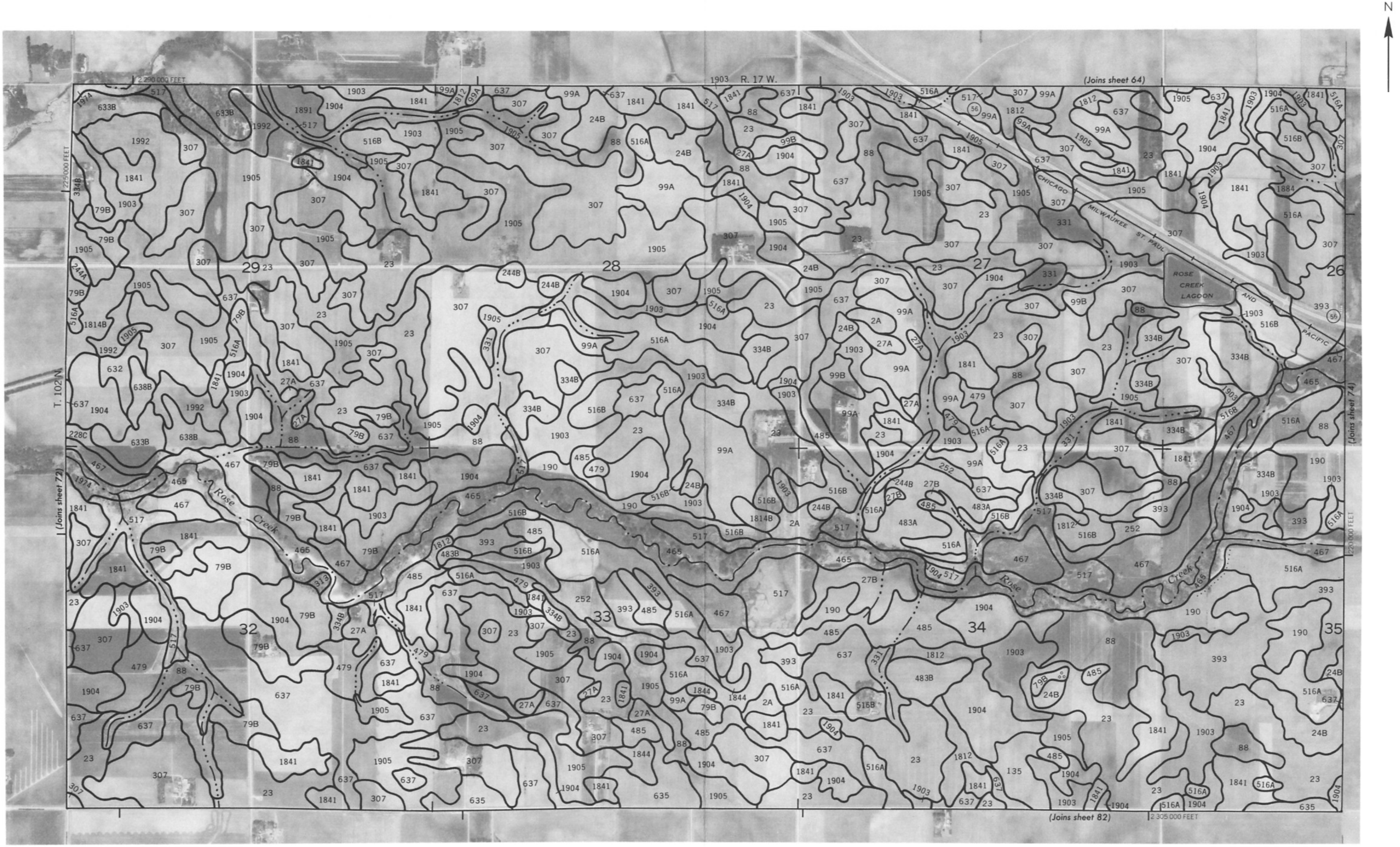
MOWER COUNTY, MINNESOTA — SHEET NUMBER 70


N
R. 14 W.
(Joins sheet 61)
(Joins sheet 69)
(Joins sheet 79)
FILLMORE COUNTY T. 102 N.
South Branch Root River
14
13
23
24
2 415 000 FEET
2 405 000 FEET
235 000 FEET
230 000 FEET
Scale 1:15 840

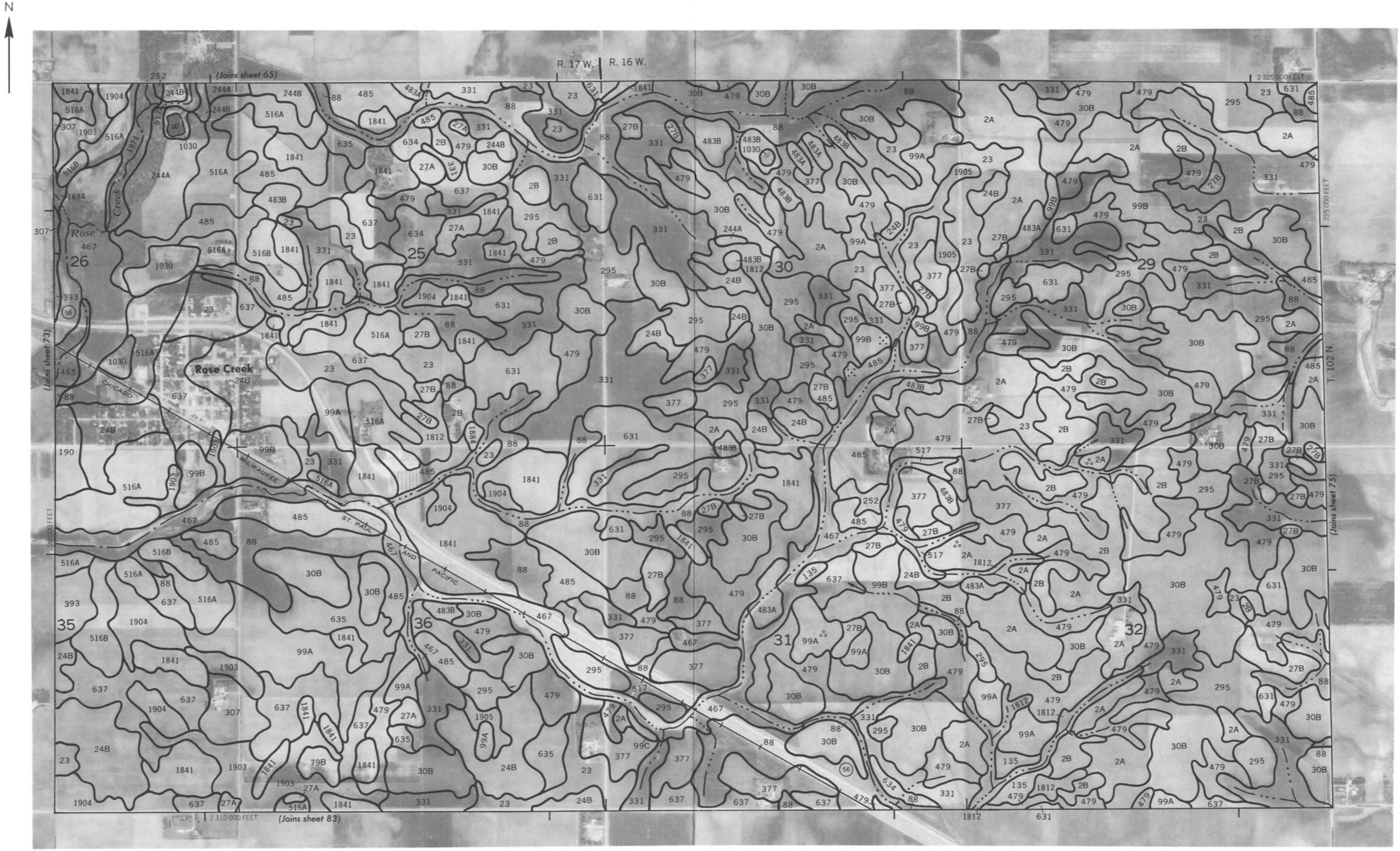

N
(Joins sheet 62)
R. 18 W.
2 255 000 FEET
225 000 FEET
FREEBORN COUNTY
T. 102 N.
(Joins sheet 72)
220 000 FEET
(Joins sheet 80)
2 270 000 FEET
Orchard Creek
JUDICIAL DITCH NO. 4
CEDAR RIVER
27
28
29
30
31
32
33
34
105


N
(Joins sheet 63)
R. 18 W.
R. 17 W.
2 285 000 FEET
Rose Creek
CEDAR RIVER
Varco
Rose Creek
218
27
26
25
30
34
35
36
31
CHICAGO MILWAUKEE ST. PAUL AND PACIFIC
CHICAGO AND NORTHWESTERN
(Joins sheet 71)
220 000 FEET
(Joins sheet 73)
T. 102 N.
225 000 FEET
(Joins sheet 81)
2 275 000 FEET

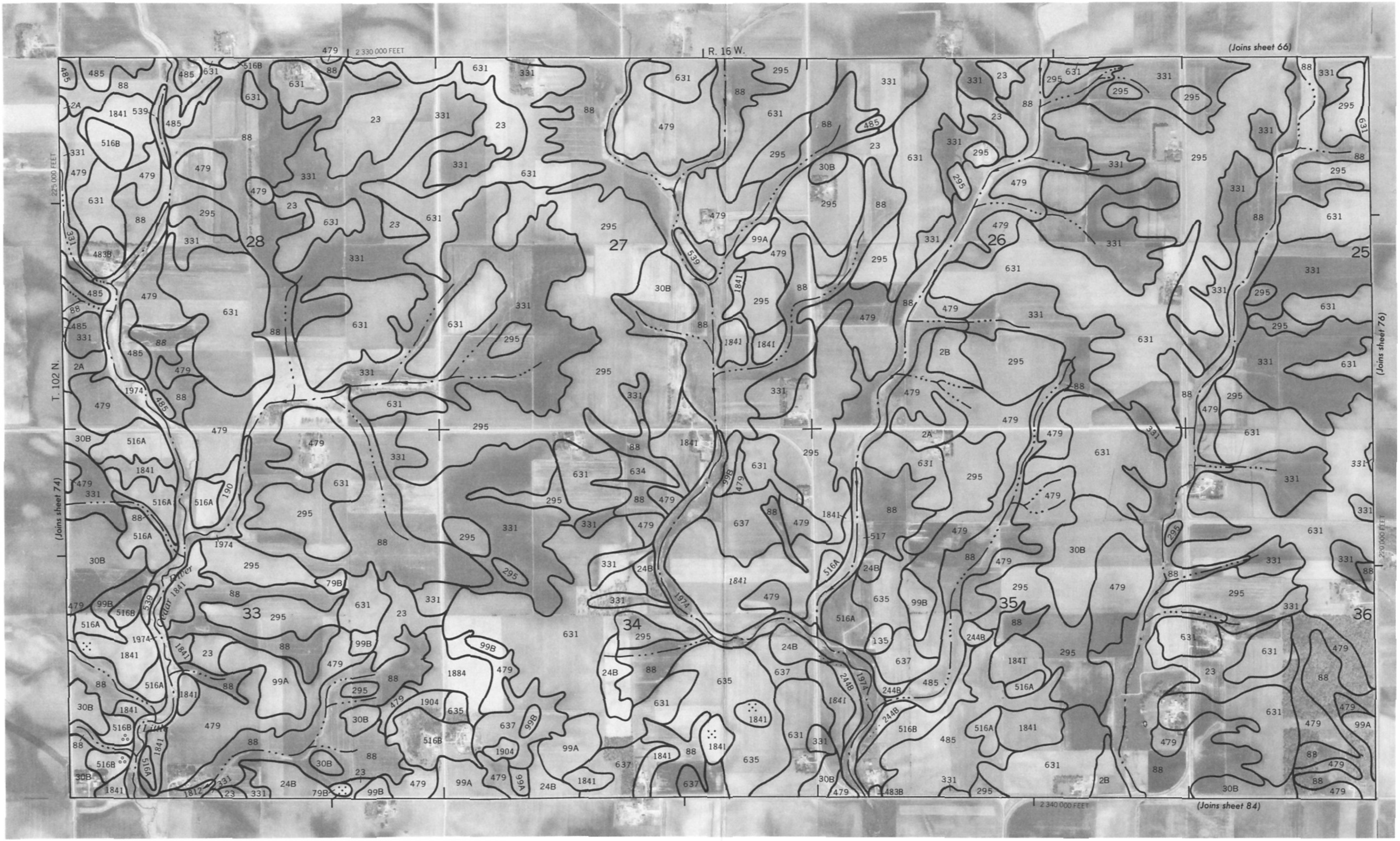
MOWER COUNTY, MINNESOTA — SHEET NUMBER 73


N
2 290 000 FEET
R. 17 W.
(Joins sheet 64)
225 000 FEET
T. 102 N.
(Joins sheet 72)
(Joins sheet 74)
220 000 FEET
(Joins sheet 82)
2 305 000 FEET
29
28
27
26
32
33
34
35
Rose Creek
CHICAGO MILWAUKEE ST. PAUL AND PACIFIC
ROSE CREEK LAGOON
56

MOWER COUNTY, MINNESOTA — SHEET NUMBER 74

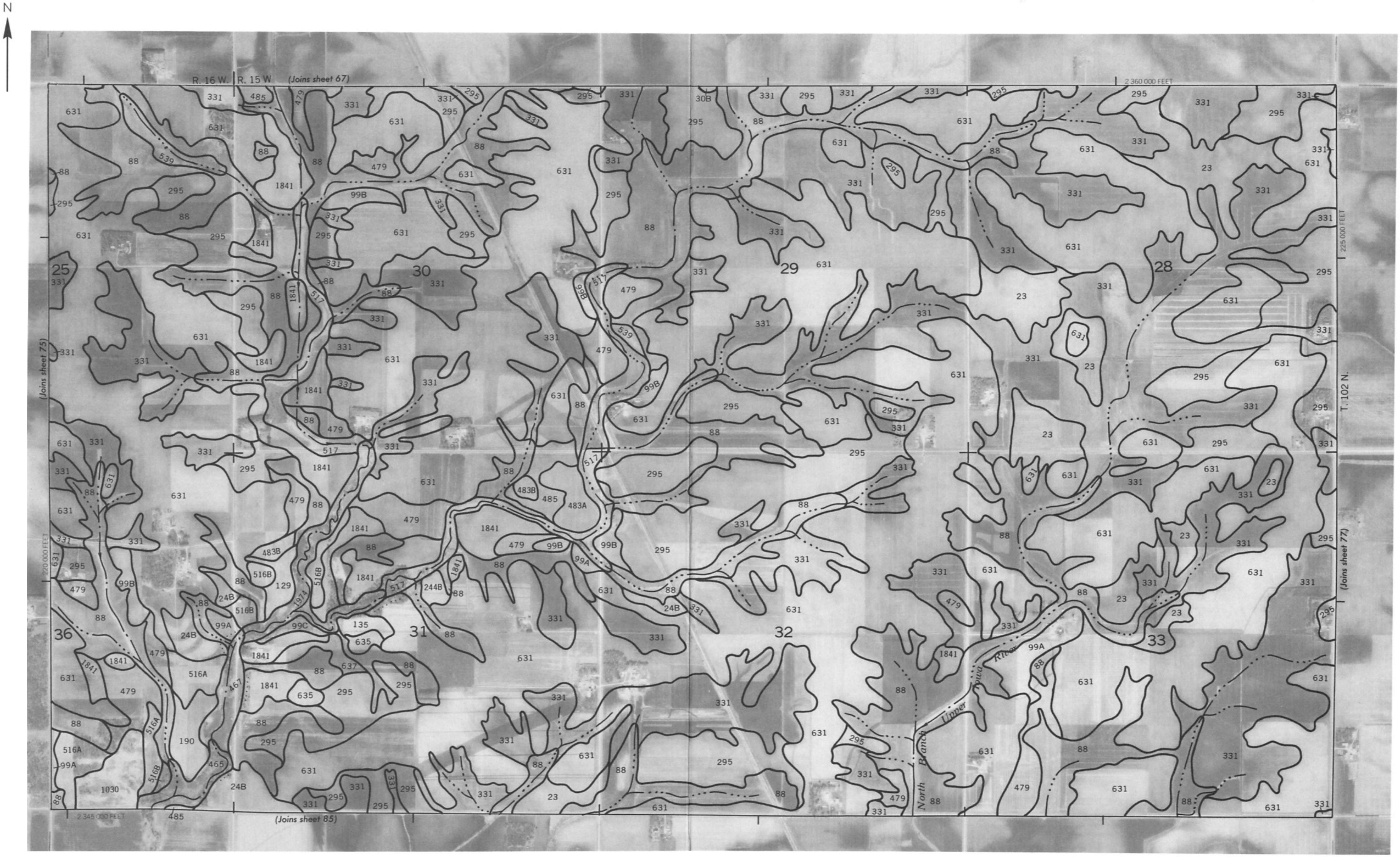

N
R. 17 W.
R. 16 W.
(Joins sheet 65)
(Joins sheet 73)
(Joins sheet 75)
(Joins sheet 83)
T. 102 N.
2 325 000 FEET
225 000 FEET
220 000 FEET
2 310 000 FEET
Rose Creek
Rose
Creek
CHICAGO
MILWAUKEE
ST. PAUL
AND
PACIFIC
56
25
26
29
30
31
32
35
36

MOWER COUNTY, MINNESOTA — SHEET NUMBER 75

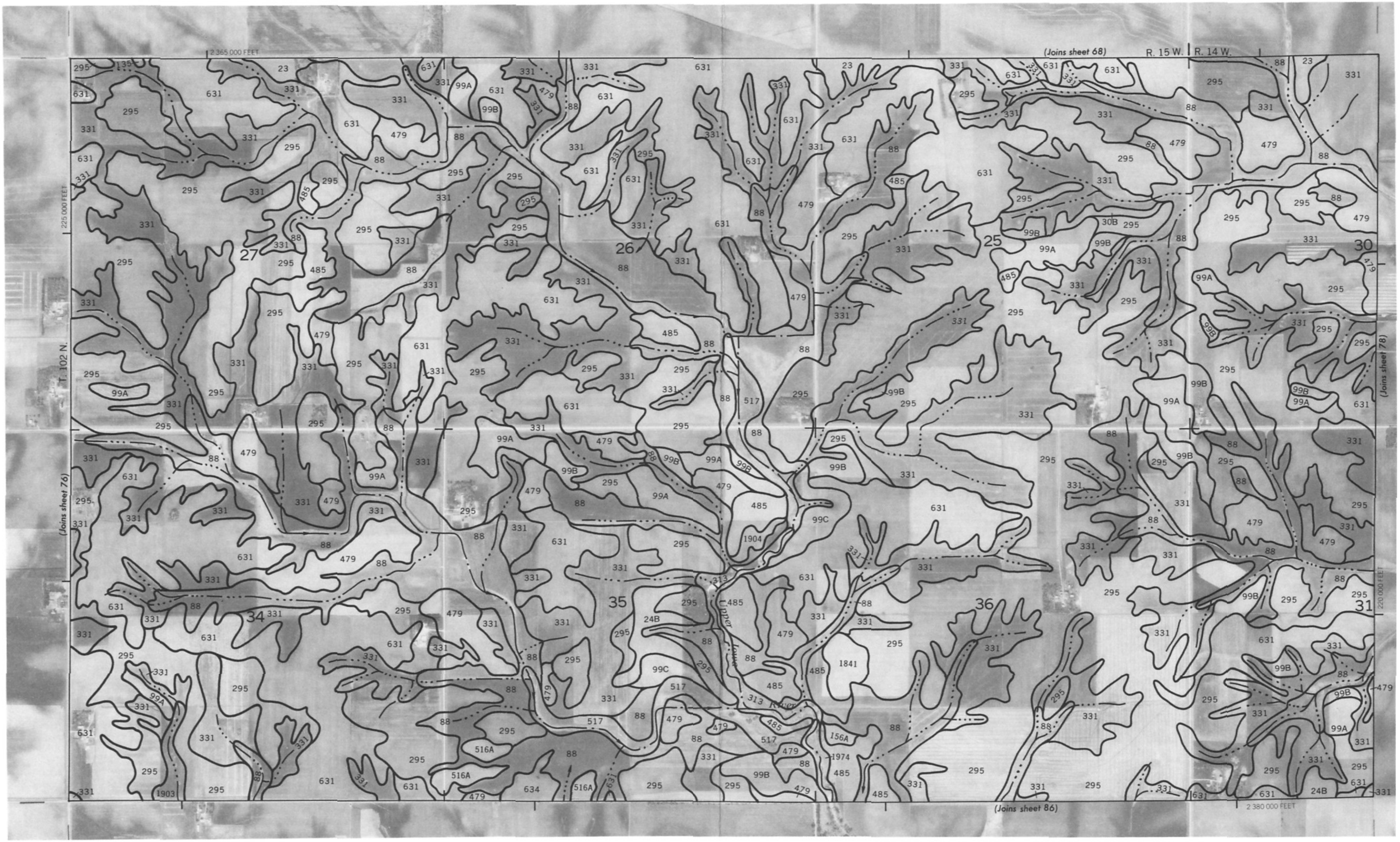


75
N
2 330 000 FEET
R. 16 W.
(Joins sheet 66)
225 000 FEET
T. 102 N.
(Joins sheet 74)
(Joins sheet 76)
220 000 FEET
(Joins sheet 84)
2 340 000 FEET
28
27
26
25
33
34
35
36
Cedar River
Little Cedar River

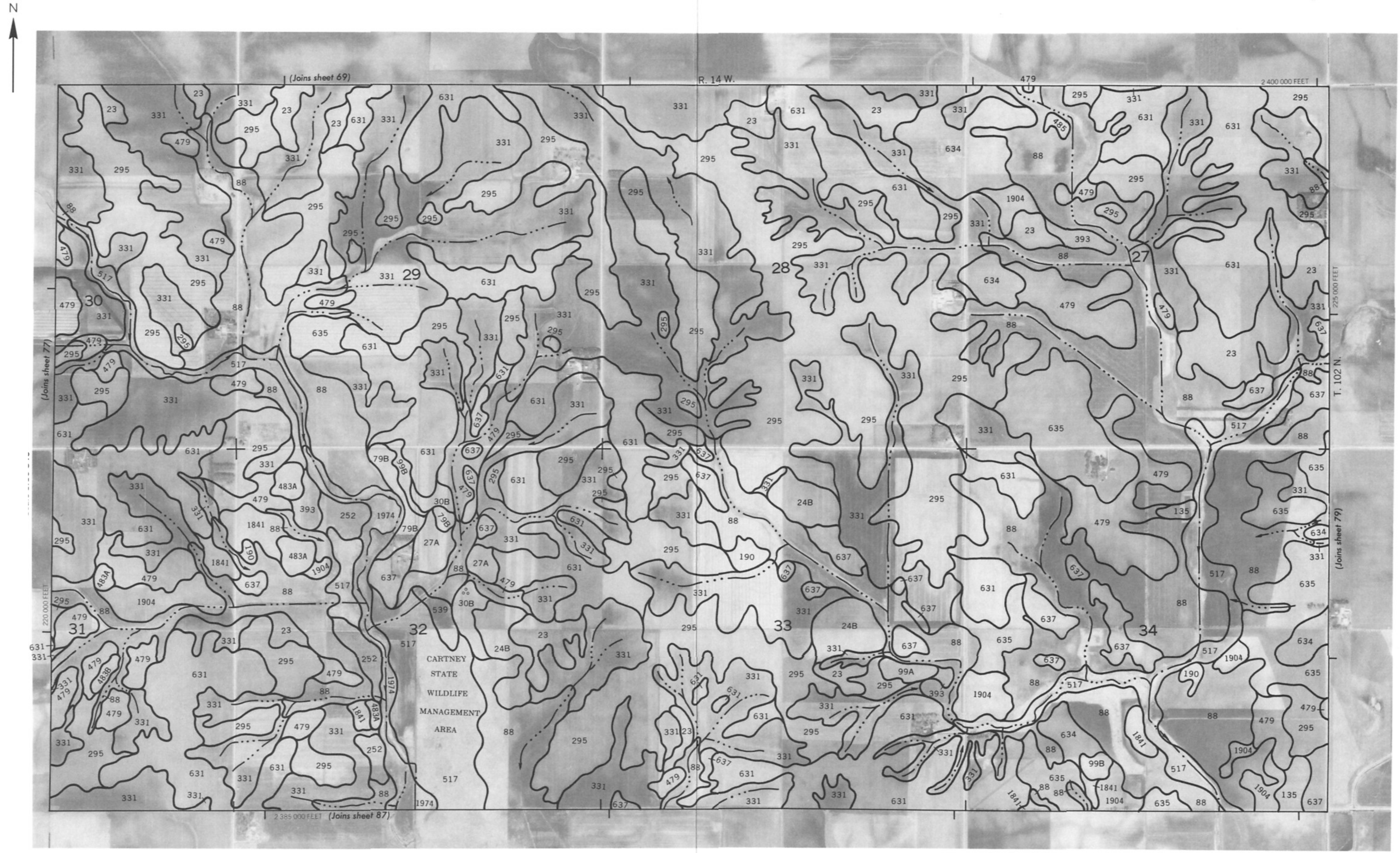
MOWER COUNTY, MINNESOTA — SHEET NUMBER 76

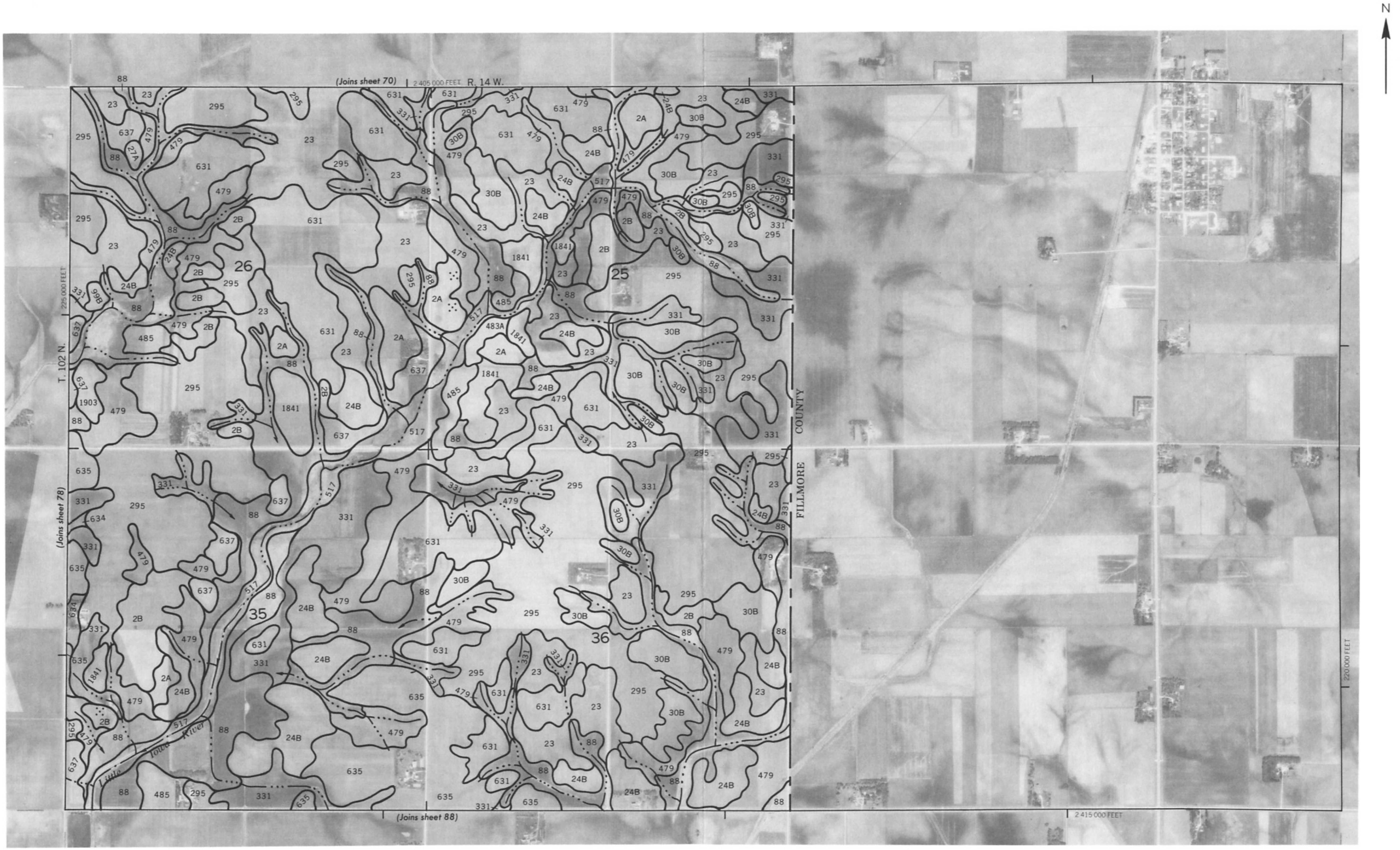

N
R. 16 W.
R. 15 W.
(Joins sheet 67)
2 360 000 FEET
225 000 FEET
T. 102 N.
(Joins sheet 77)
(Joins sheet 75)
220 000 FEET
2 345 000 FEET
(Joins sheet 85)
25
30
29
28
36
31
32
33
North Branch Upper Iowa River

MOWER COUNTY, MINNESOTA — SHEET NUMBER 77

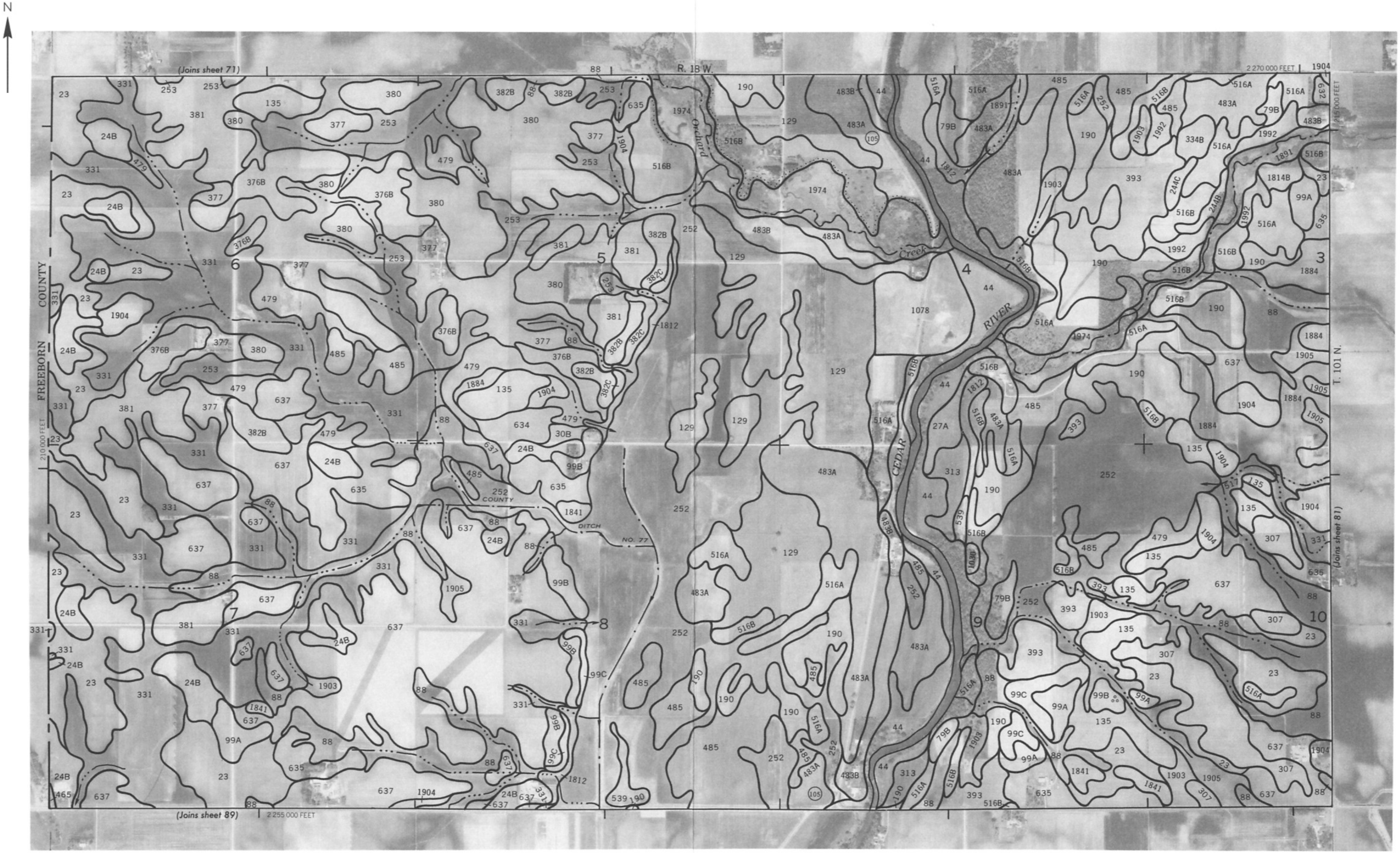

N
(Joins sheet 68)
R. 15 W.
R. 14 W.
2 365 000 FEET
225 000 FEET
T. 102 N.
(Joins sheet 76)
(Joins sheet 78)
220 000 FEET
(Joins sheet 86)
2 380 000 FEET
25
26
27
30
31
34
35
36
Upper Iowa River

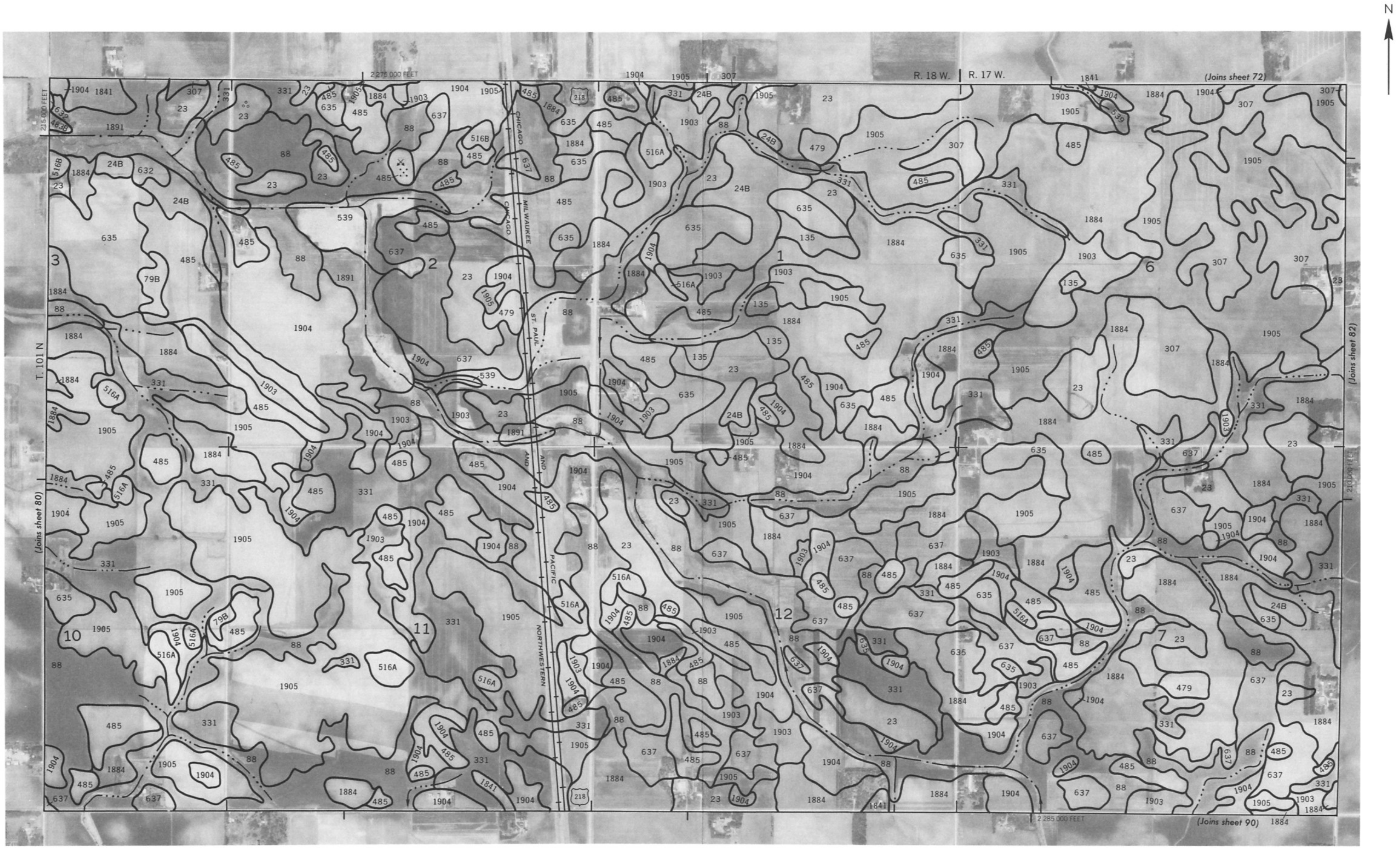
MOWER COUNTY, MINNESOTA — SHEET NUMBER 78

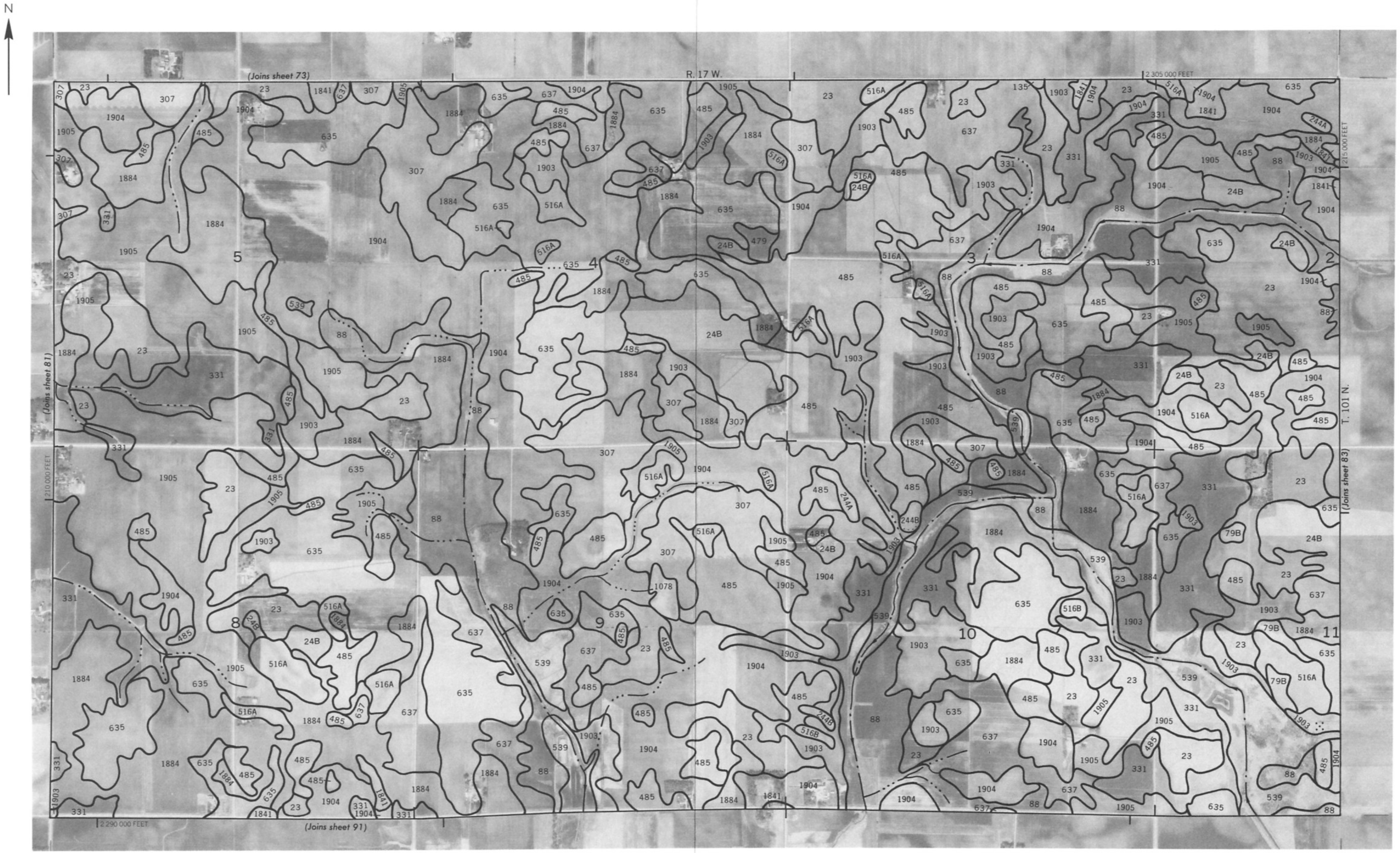

N
(Joins sheet 69)
R. 14 W.
2 400 000 FEET
225 000 FEET
T. 102 N.
(Joins sheet 79)
(Joins sheet 77)
220 000 FEET
2 385 000 FEET
(Joins sheet 87)
27
28
29
30
31
32
33
34
CARTNEY
STATE
WILDLIFE
MANAGEMENT
AREA


N
(Joins sheet 70)
2 405 000 FEET
R. 14 W.
T. 102 N.
225 000 FEET
(Joins sheet 78)
(Joins sheet 88)
2 415 000 FEET
220 000 FEET
FILLMORE COUNTY
26
25
35
36
Little Iowa River
23
24B
295
631
479
88
30B
331
2A
2B
27A
517
1841
485
483A
637
635
634
99B
1903

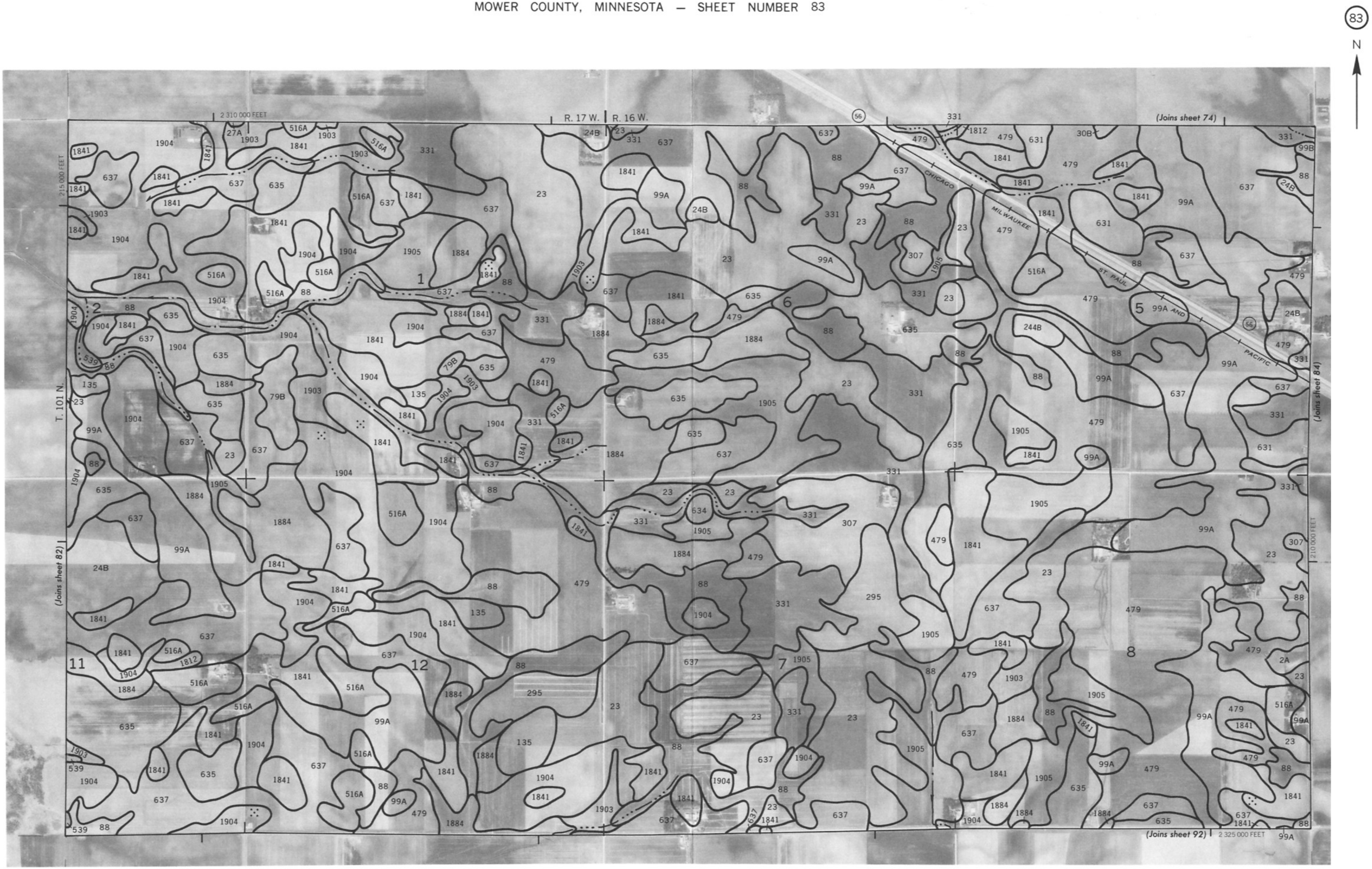
MOWER COUNTY, MINNESOTA — SHEET NUMBER 80

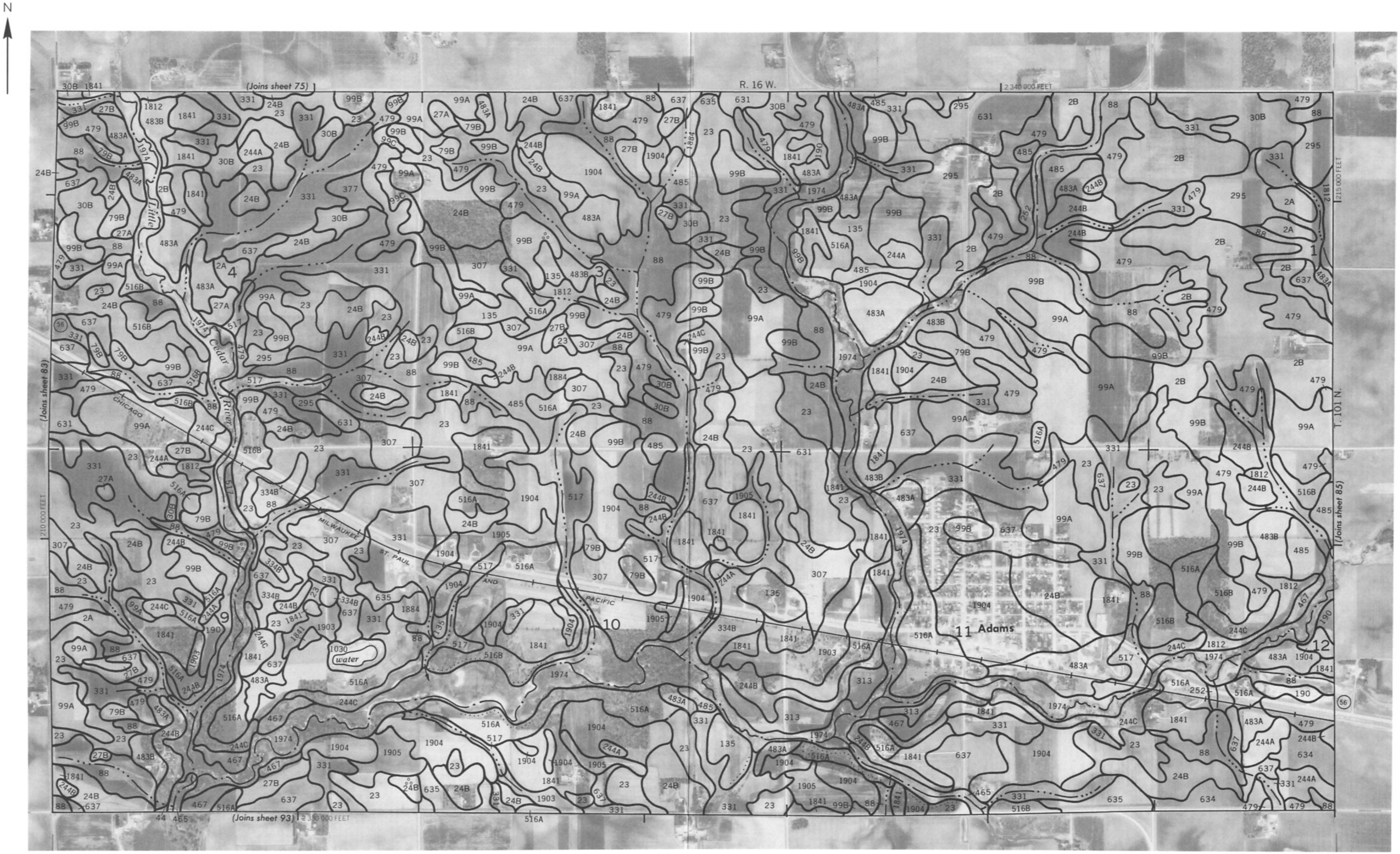

N
(Joins sheet 71)
R. 18 W.
2 270 000 FEET
215 000 FEET
T. 101 N.
(Joins sheet 81)
(Joins sheet 89)
2 255 000 FEET
210 000 FEET
FREEBORN COUNTY
Orchard
Creek
CEDAR
RIVER
COUNTY
DITCH
NO. 77
105
3
4
5
6
7
8
9
10

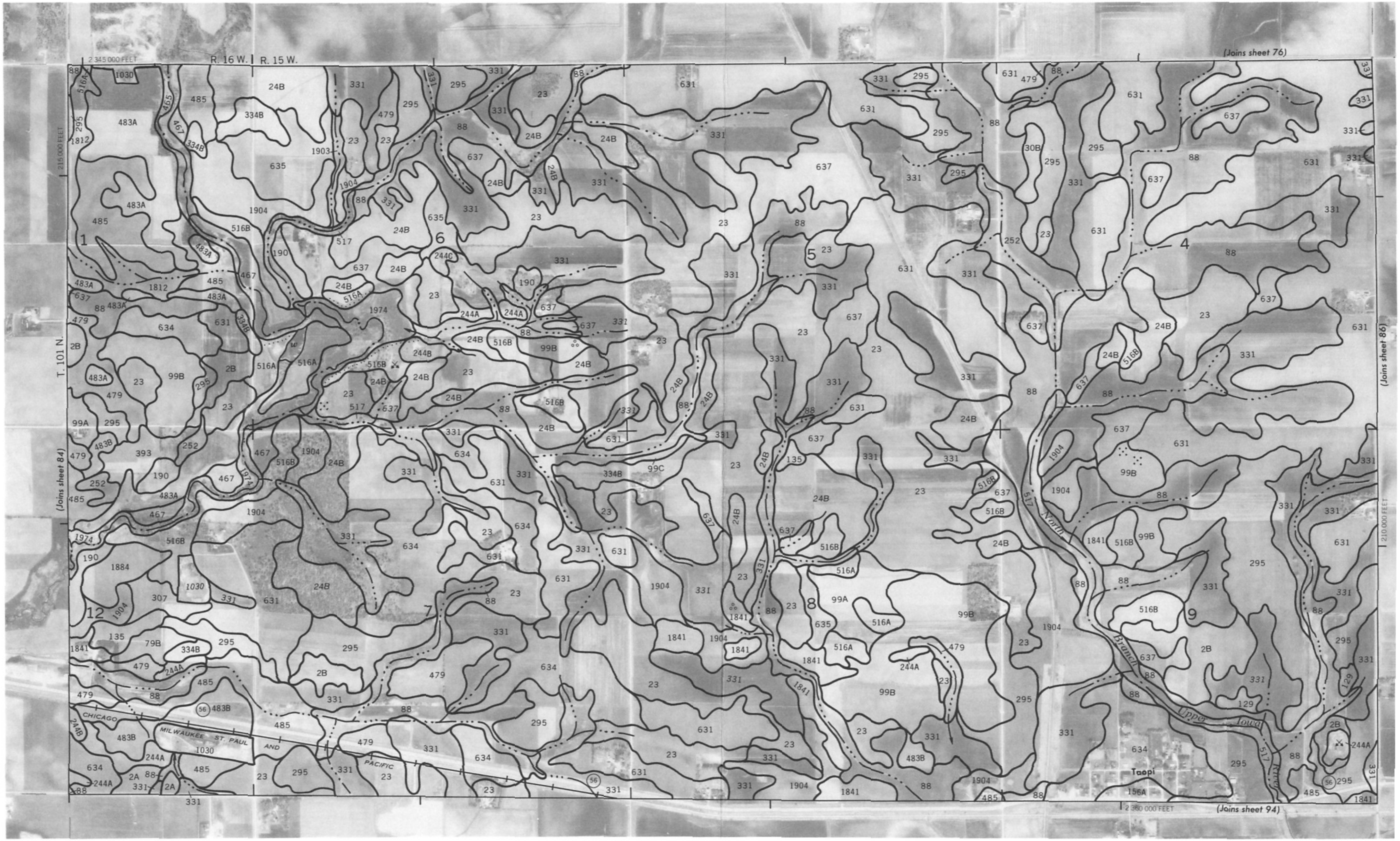

N
R. 18 W.
R. 17 W.
T. 101 N.
(Joins sheet 72)
(Joins sheet 82)
(Joins sheet 90)
(Joins sheet 80)
2 275 000 FEET
2 285 000 FEET
215 000 FEET
210 000 FEET
CHICAGO MILWAUKEE ST. PAUL AND PACIFIC
CHICAGO AND NORTHWESTERN
218
1
2
3
6
7
10
11
12


N
(Joins sheet 73)
R. 17 W.
2 305 000 FEET
215 000 FEET
T. 101 N.
(Joins sheet 83)
(Joins sheet 81)
210 000 FEET
2 290 000 FEET
(Joins sheet 91)
5
4
3
2
8
9
10
11

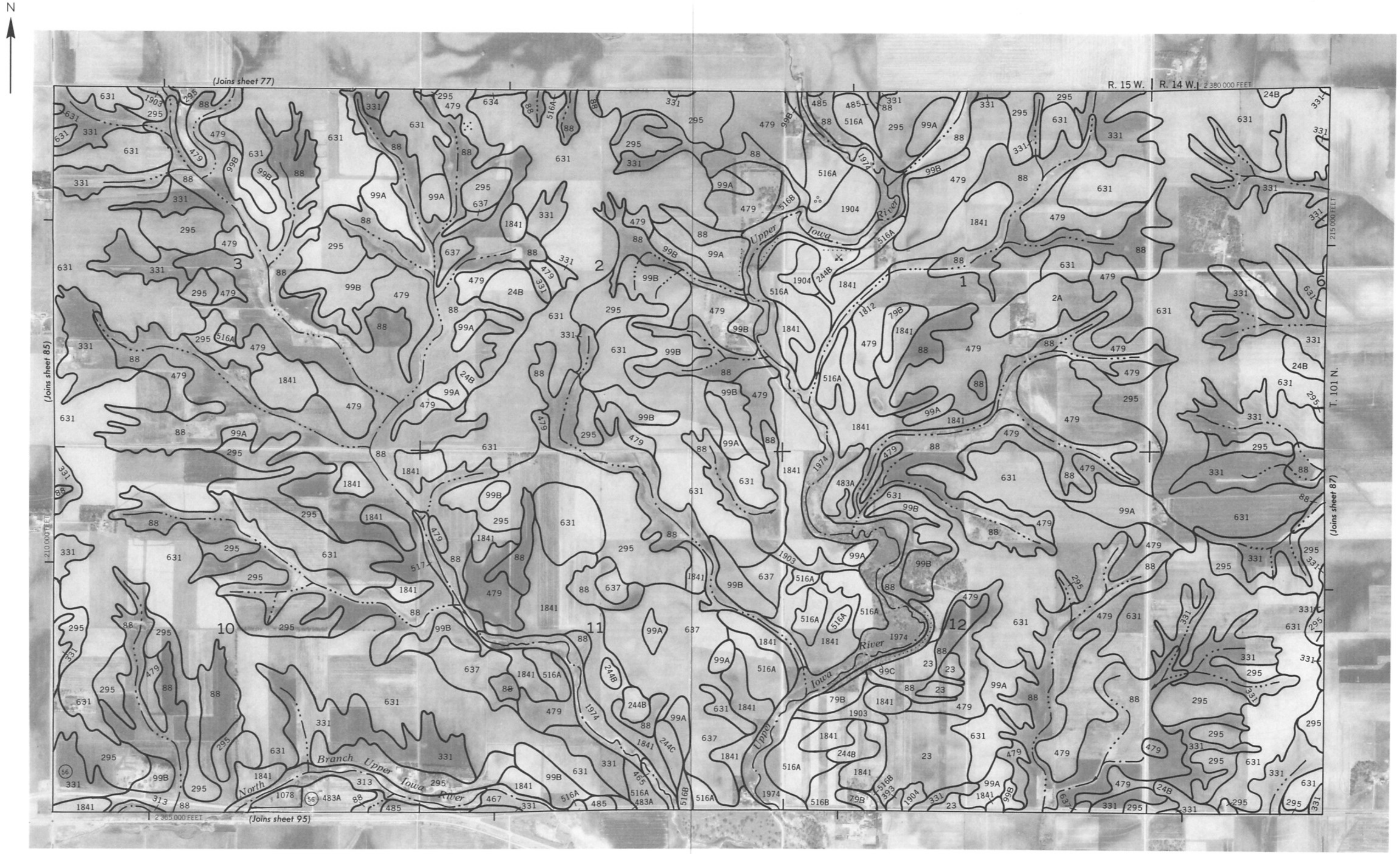
MOWER COUNTY, MINNESOTA — SHEET NUMBER 83

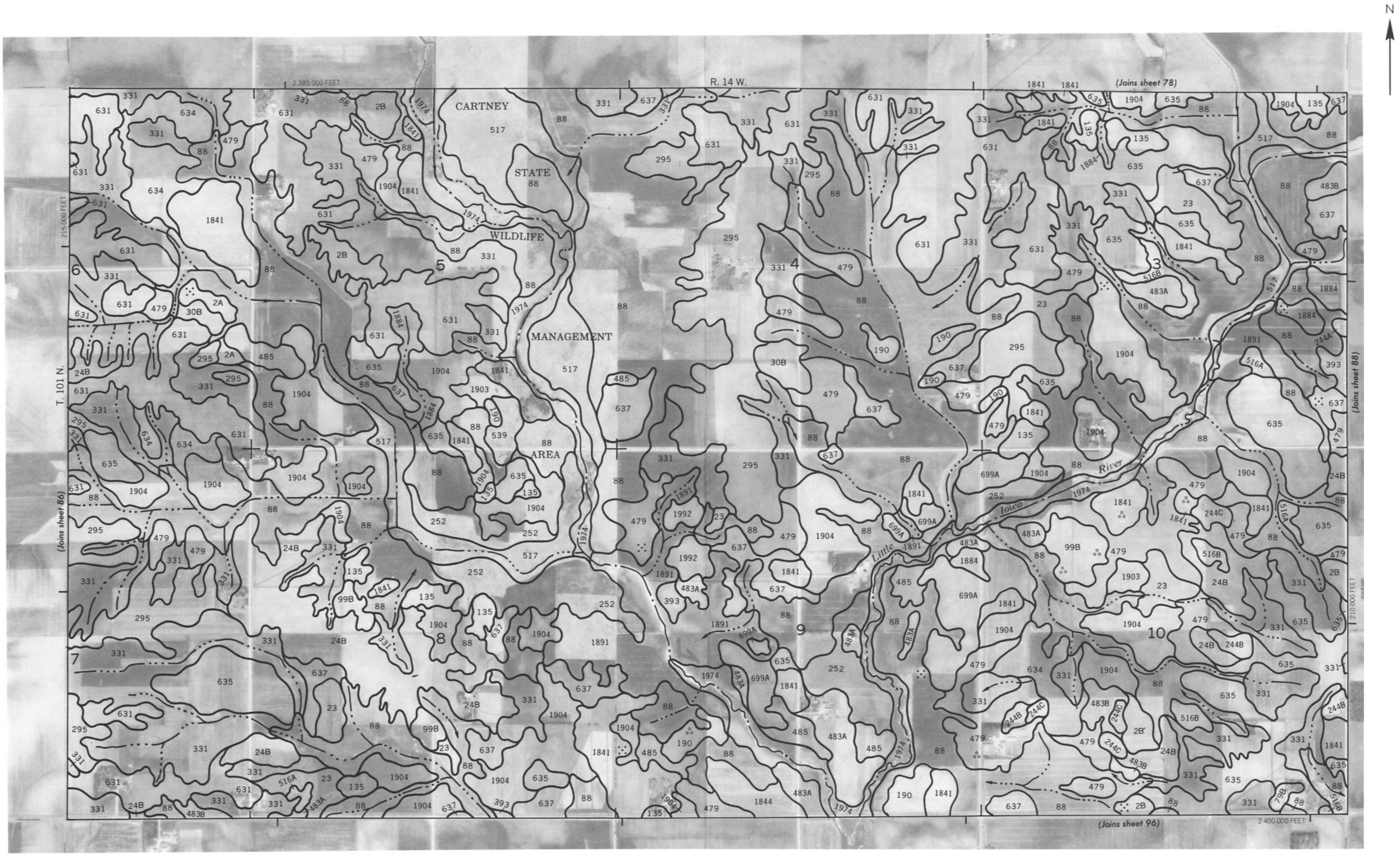

83
N
2 310 000 FEET
R. 17 W.
R. 16 W.
56
(Joins sheet 74)
215 000 FEET
T. 101 N.
(Joins sheet 82)
(Joins sheet 84)
210 000 FEET
(Joins sheet 92)
2 325 000 FEET
CHICAGO MILWAUKEE ST. PAUL AND PACIFIC
1
2
5
6
7
8
11
12


N
(Joins sheet 75)
R. 16 W.
2 340 000 FEET
215 000 FEET
T. 101 N.
(Joins sheet 85)
(Joins sheet 83)
210 000 FEET
(Joins sheet 93)
2 330 000 FEET
Little
Cedar
River
CHICAGO
MILWAUKEE
ST. PAUL
AND
PACIFIC
Adams
water
56
1
2
3
4
9
10
11
12

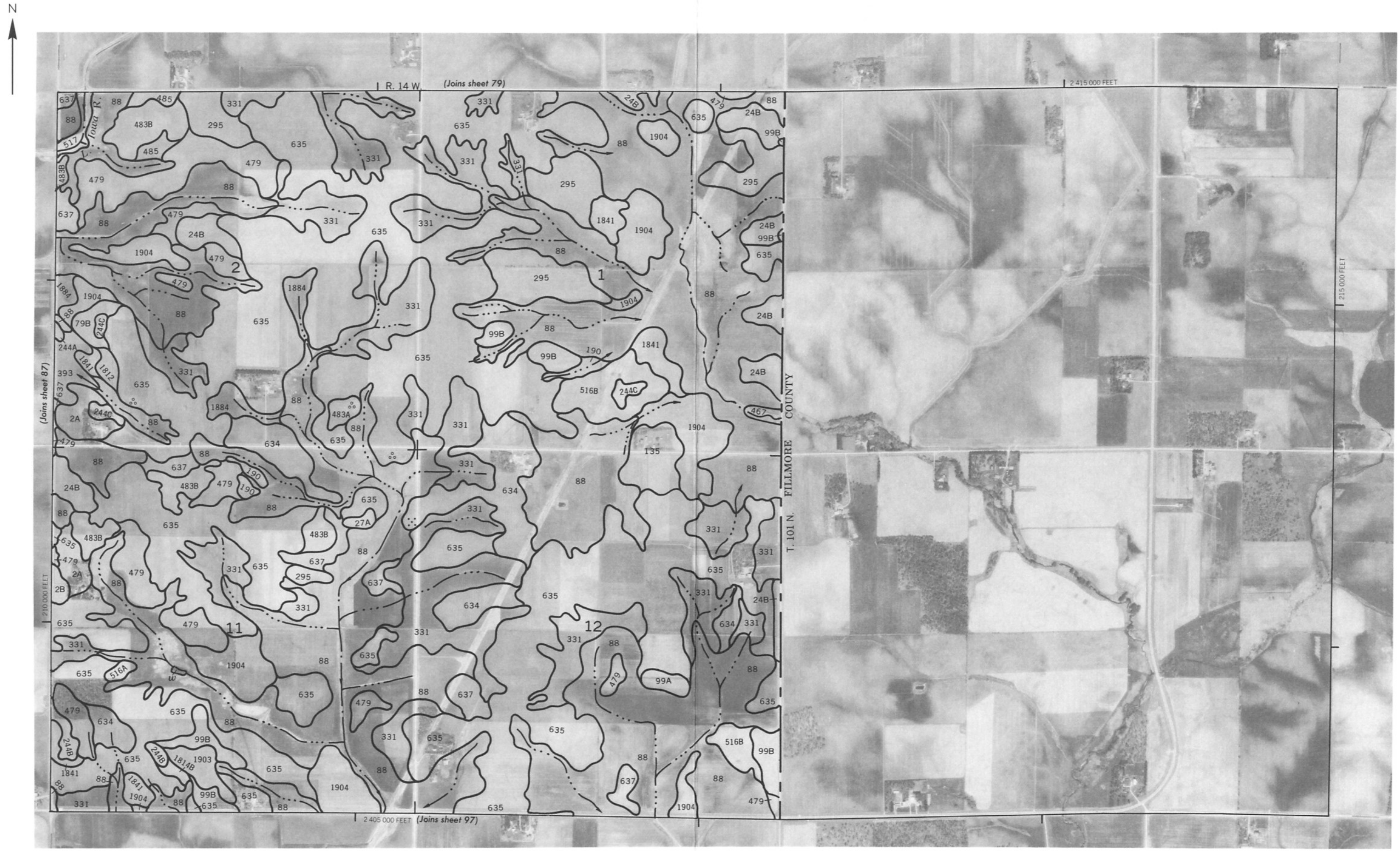

N
(Joins sheet 76)
(Joins sheet 84)
(Joins sheet 86)
(Joins sheet 94)
R. 16 W.
R. 15 W.
T. 101 N.
2 345 000 FEET
2 360 000 FEET
215 000 FEET
210 000 FEET
CHICAGO MILWAUKEE ST. PAUL AND PACIFIC
North Branch
Upper Iowa River
Taopi
56
1
4
5
6
7
8
9
12

MOWER COUNTY, MINNESOTA — SHEET NUMBER 86

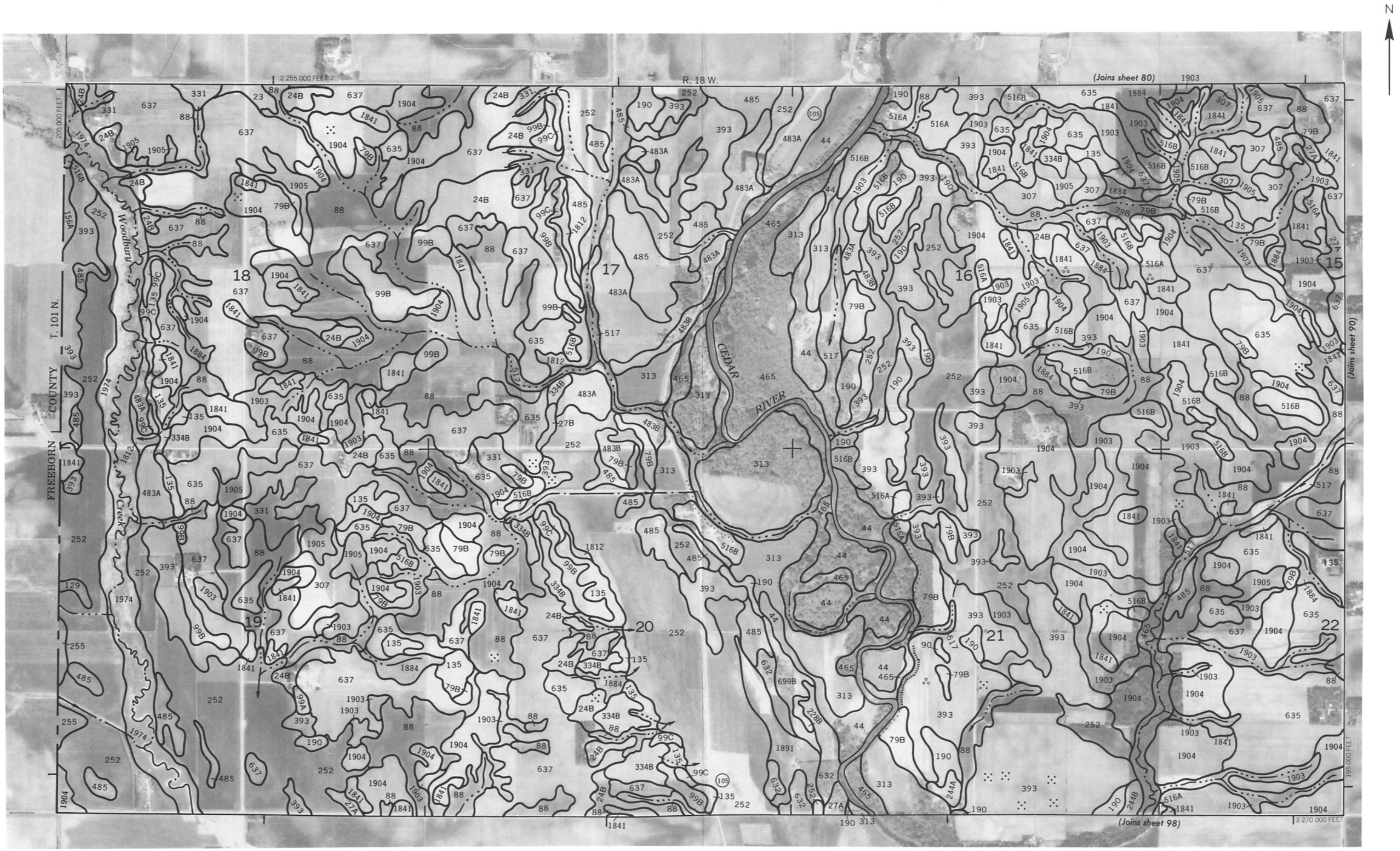

N
(Joins sheet 77)
R. 15 W.
R. 14 W.
2 380 000 FEET
215 000 FEET
T. 101 N.
(Joins sheet 85)
(Joins sheet 87)
210 000 FEET
2 365 000 FEET
(Joins sheet 95)
Upper Iowa River
North Branch Upper Iowa River
1
2
3
6
7
10
11
12
56


N
2 385 000 FEET
R. 14 W.
(Joins sheet 78)
215 000 FEET
T. 101 N.
(Joins sheet 86)
(Joins sheet 88)
210 000 FEET
(Joins sheet 96)
2 400 000 FEET
CARTNEY
STATE
WILDLIFE
MANAGEMENT
AREA
Little Iowa River
6
5
4
3
7
8
9
10

MOWER COUNTY, MINNESOTA — SHEET NUMBER 88

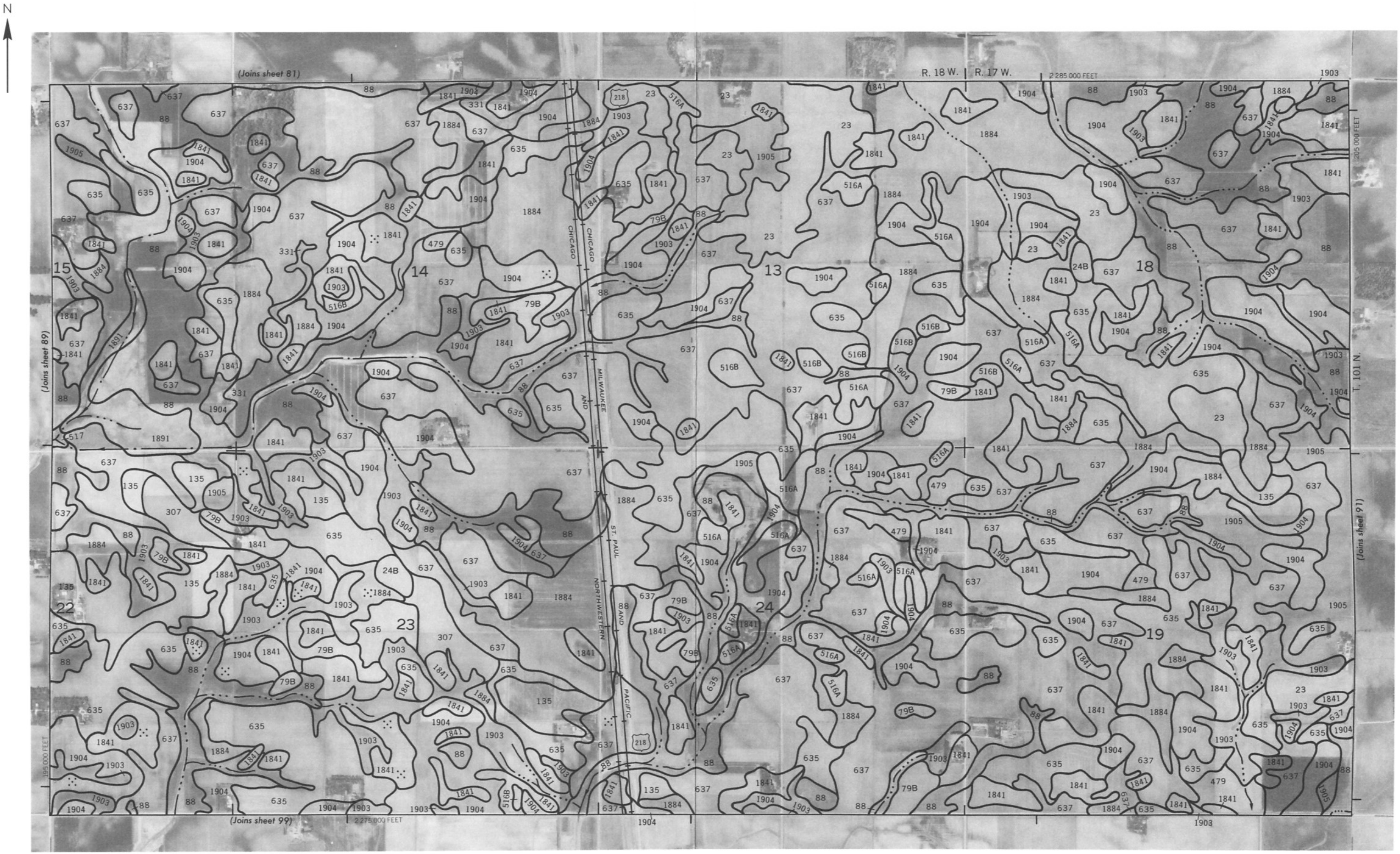

N
R. 14 W.
(Joins sheet 79)
2 415 000 FEET
215 000 FEET
(Joins sheet 87)
210 000 FEET
2 405 000 FEET
(Joins sheet 97)
T. 101 N.
FILLMORE COUNTY
Iowa R.
1
2
11
12

MOWER COUNTY, MINNESOTA — SHEET NUMBER 89

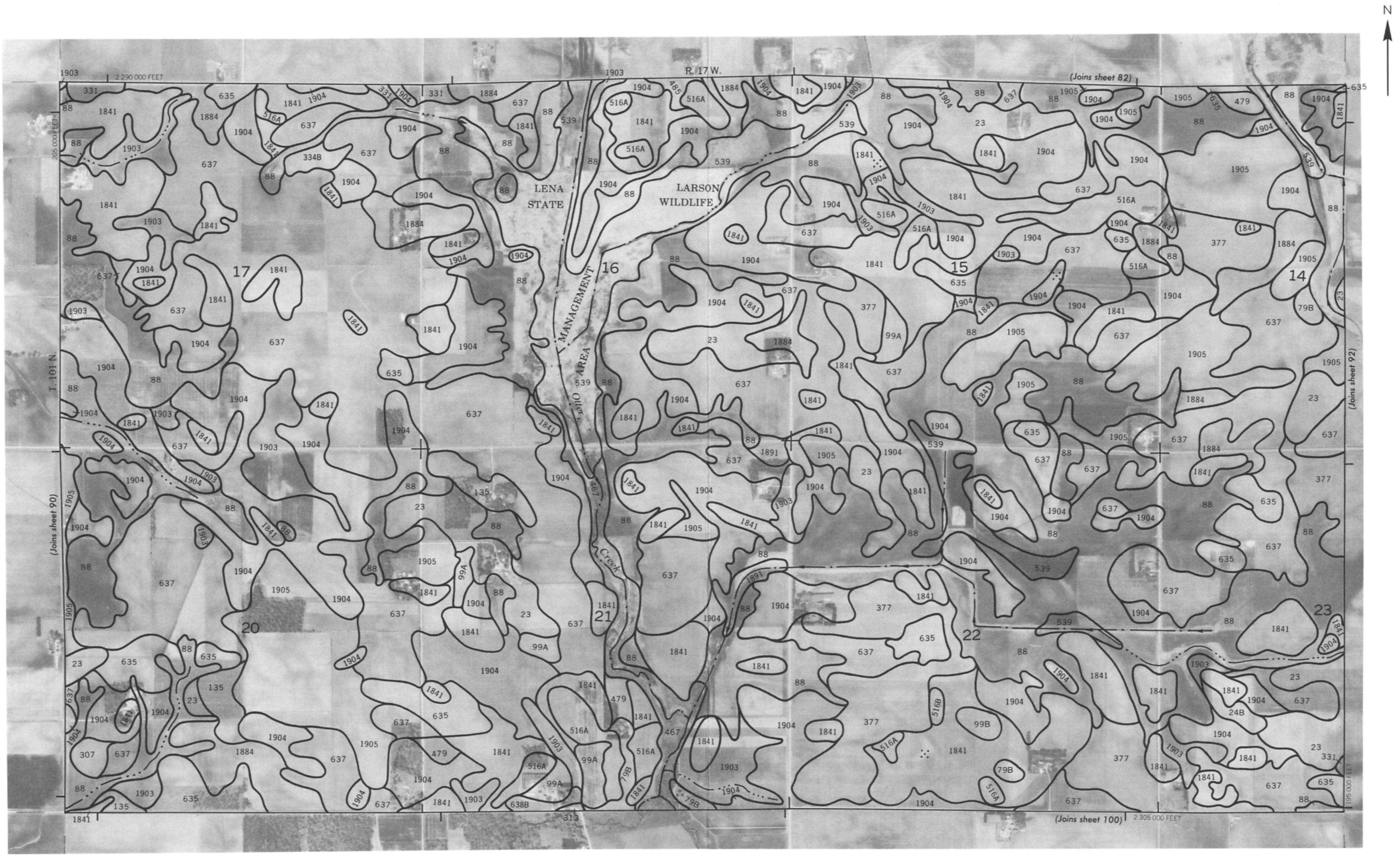

N
R. 18 W.
2 255 000 FEET
(Joins sheet 80)
205 000 FEET
T. 101 N.
FREEBORN COUNTY
Woodbury Creek
CEDAR RIVER
105
18
17
16
15
19
20
21
22
(Joins sheet 90)
195 000 FEET
2 270 000 FEET
(Joins sheet 98)

(90)

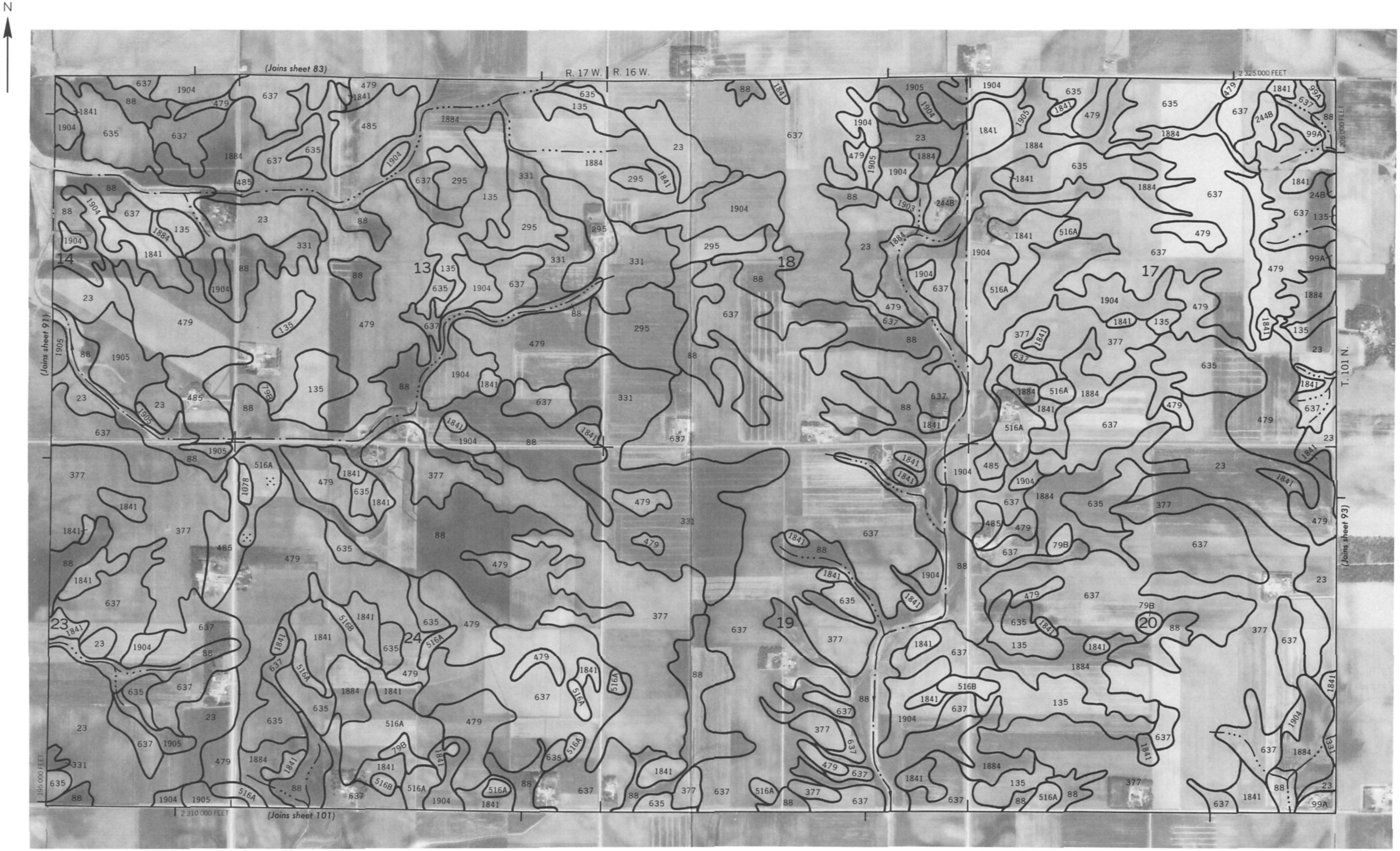
MOWER COUNTY, MINNESOTA — SHEET NUMBER 90

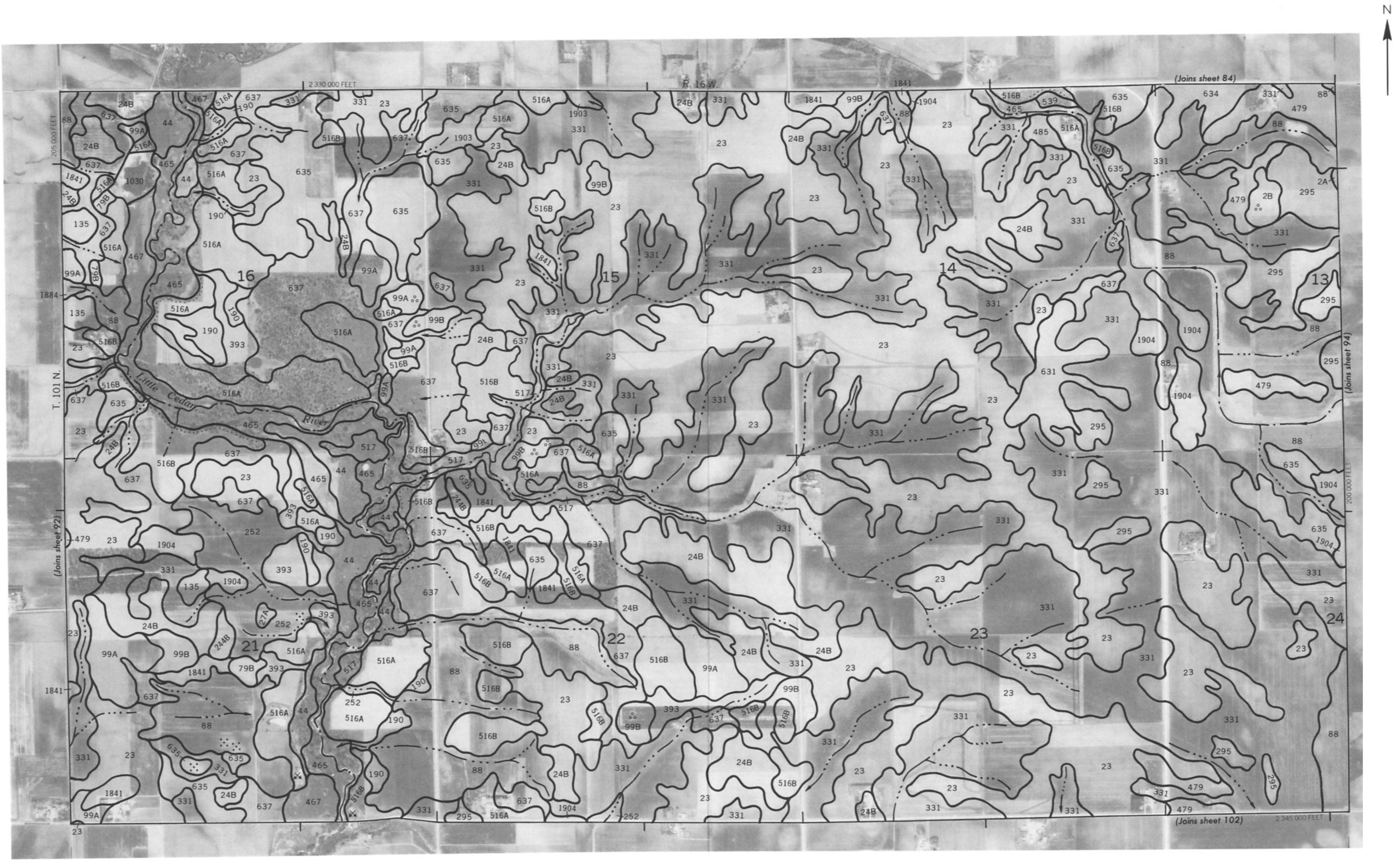

N
(Joins sheet 81)
R. 18 W.
R. 17 W.
2 285 000 FEET
205 000 FEET
T. 101 N.
(Joins sheet 91)
(Joins sheet 99)
2 275 000 FEET
195 000 FEET
(Joins sheet 89)
15
14
13
18
22
23
24
19
CHICAGO
CHICAGO MILWAUKEE ST. PAUL AND PACIFIC
AND NORTHWESTERN
218
218

MOWER COUNTY, MINNESOTA — SHEET NUMBER 91

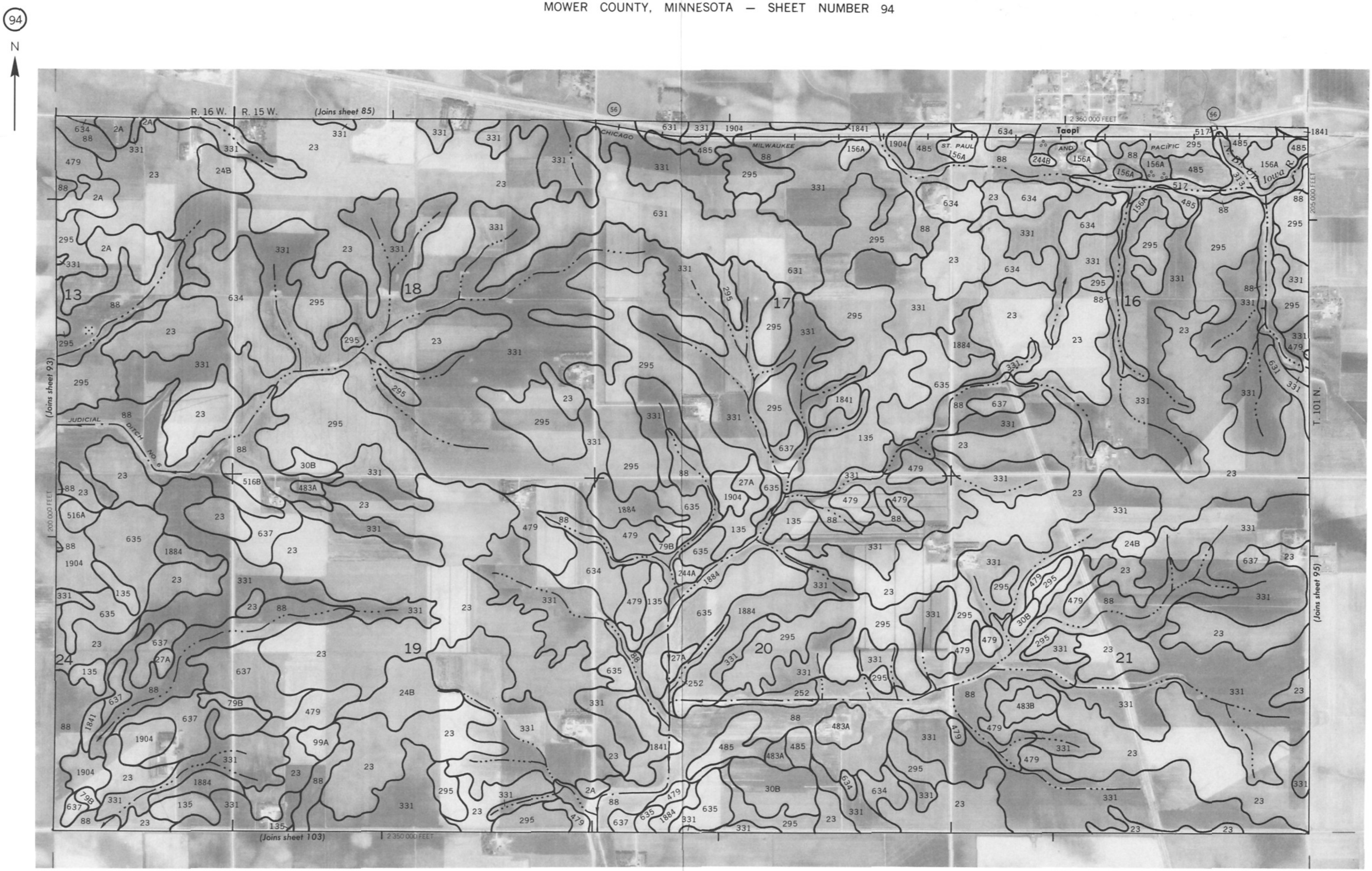

91
N
R. 17 W.
T. 101 N.
2 290 000 FEET
205 000 FEET
2 305 000 FEET
195 000 FEET
(Joins sheet 82)
(Joins sheet 92)
(Joins sheet 100)
(Joins sheet 90)
LENA
STATE
LARSON
WILDLIFE
MANAGEMENT
AREA
Otter
Creek
17
16
15
14
20
21
22
23

MOWER COUNTY, MINNESOTA — SHEET NUMBER 92

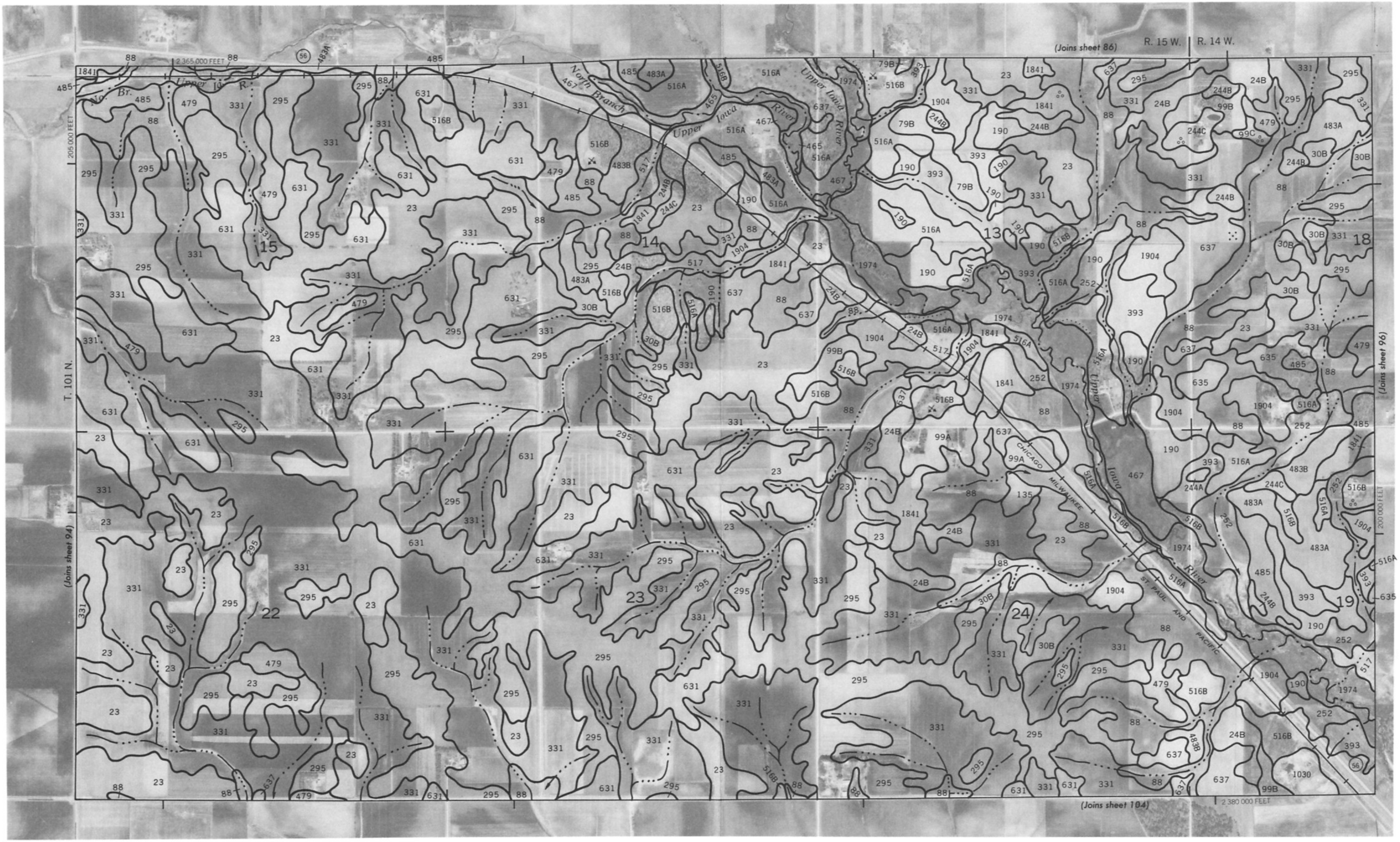

N
(Joins sheet 83)
R. 17 W.
R. 16 W.
2 325 000 FEET
205 000 FEET
(Joins sheet 91)
(Joins sheet 93)
T. 101 N.
195 000 FEET
2 310 000 FEET
(Joins sheet 101)
14
13
18
17
23
24
19
20


N
(Joins sheet 84)
(Joins sheet 94)
(Joins sheet 102)
(Joins sheet 92)
R. 16 W.
T. 101 N.
2 330 000 FEET
2 345 000 FEET
205 000 FEET
200 000 FEET
Little Cedar River
16
15
14
13
21
22
23
24

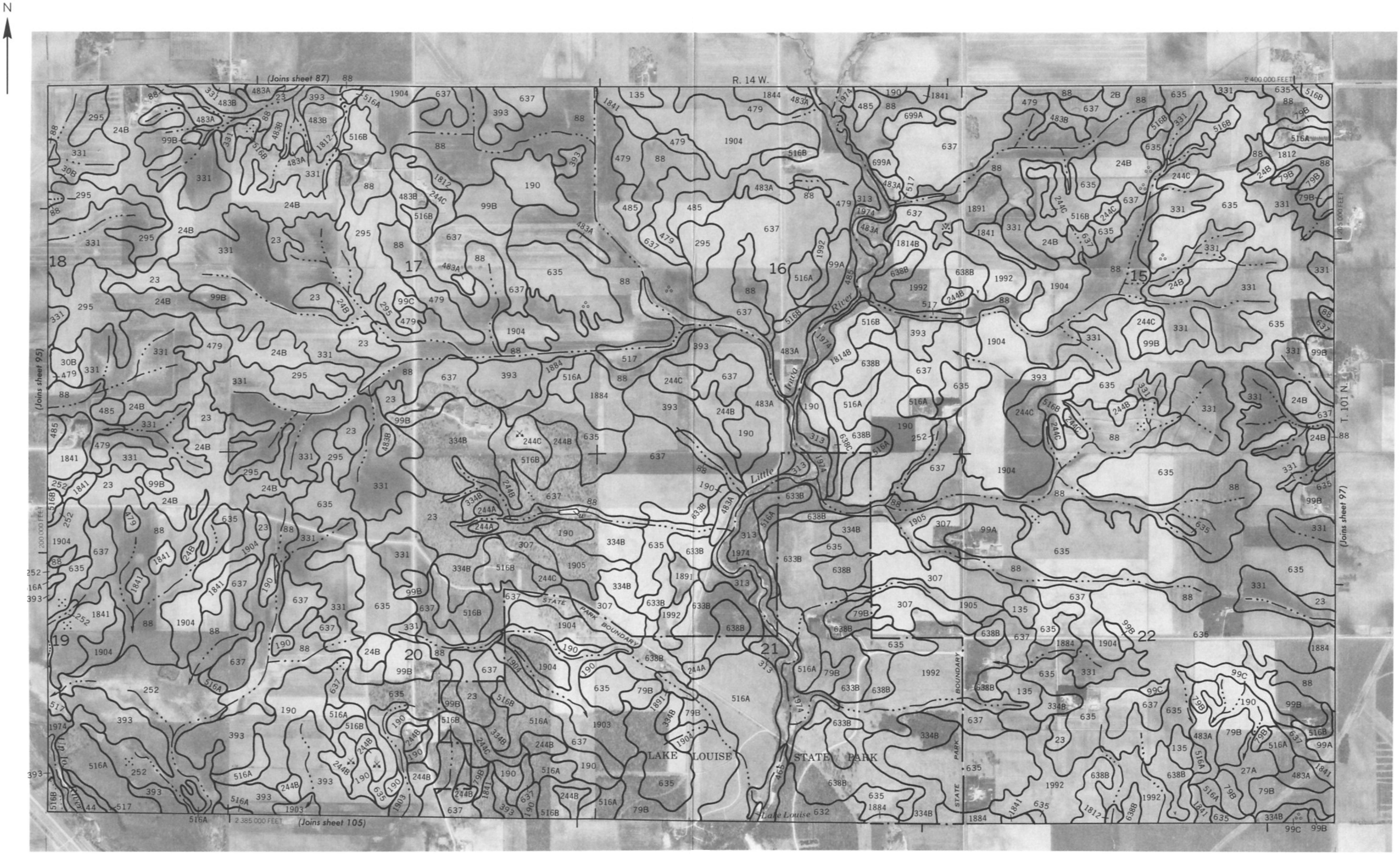
MOWER COUNTY, MINNESOTA — SHEET NUMBER 94


N
R. 16 W.
R. 15 W.
(Joins sheet 85)
(Joins sheet 93)
(Joins sheet 95)
(Joins sheet 103)
T. 101 N.
Taopi
CHICAGO
MILWAUKEE
ST. PAUL
AND
PACIFIC
JUDICIAL DITCH NO. 6
Little Iowa R.
2 350 000 FEET
205 000 FEET
200 000 FEET
56
13
16
17
18
19
20
21
24

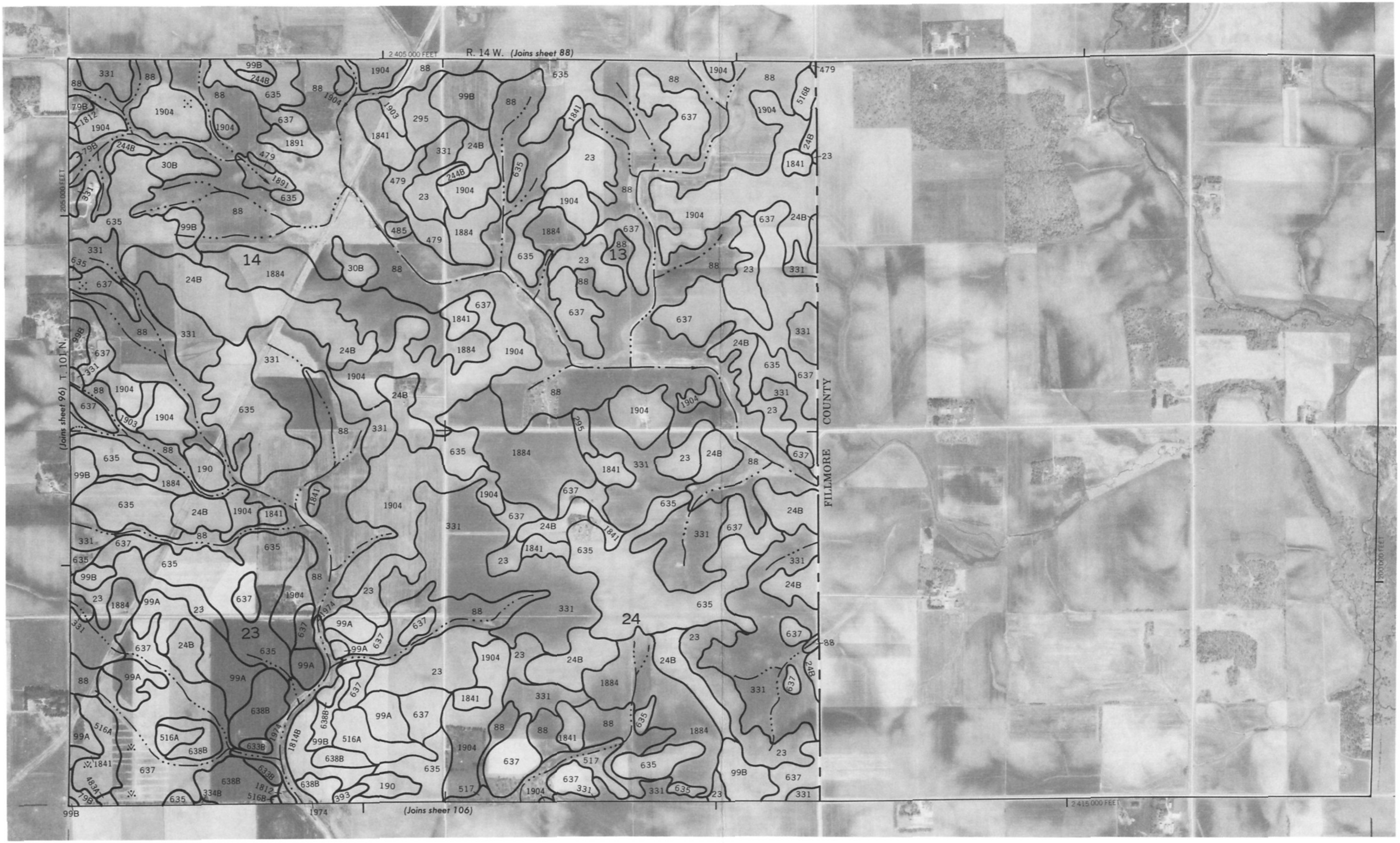
MOWER COUNTY, MINNESOTA — SHEET NUMBER 95


95
N
(Joins sheet 86)
R. 15 W.
R. 14 W.
2 365 000 FEET
205 000 FEET
T. 101 N.
(Joins sheet 94)
(Joins sheet 96)
200 000 FEET
(Joins sheet 104)
2 380 000 FEET
No. Br. Upper Ia. R.
North Branch Upper Iowa River
Upper Iowa River
CHICAGO MILWAUKEE ST. PAUL AND PACIFIC
56
15
14
13
18
22
23
24
19

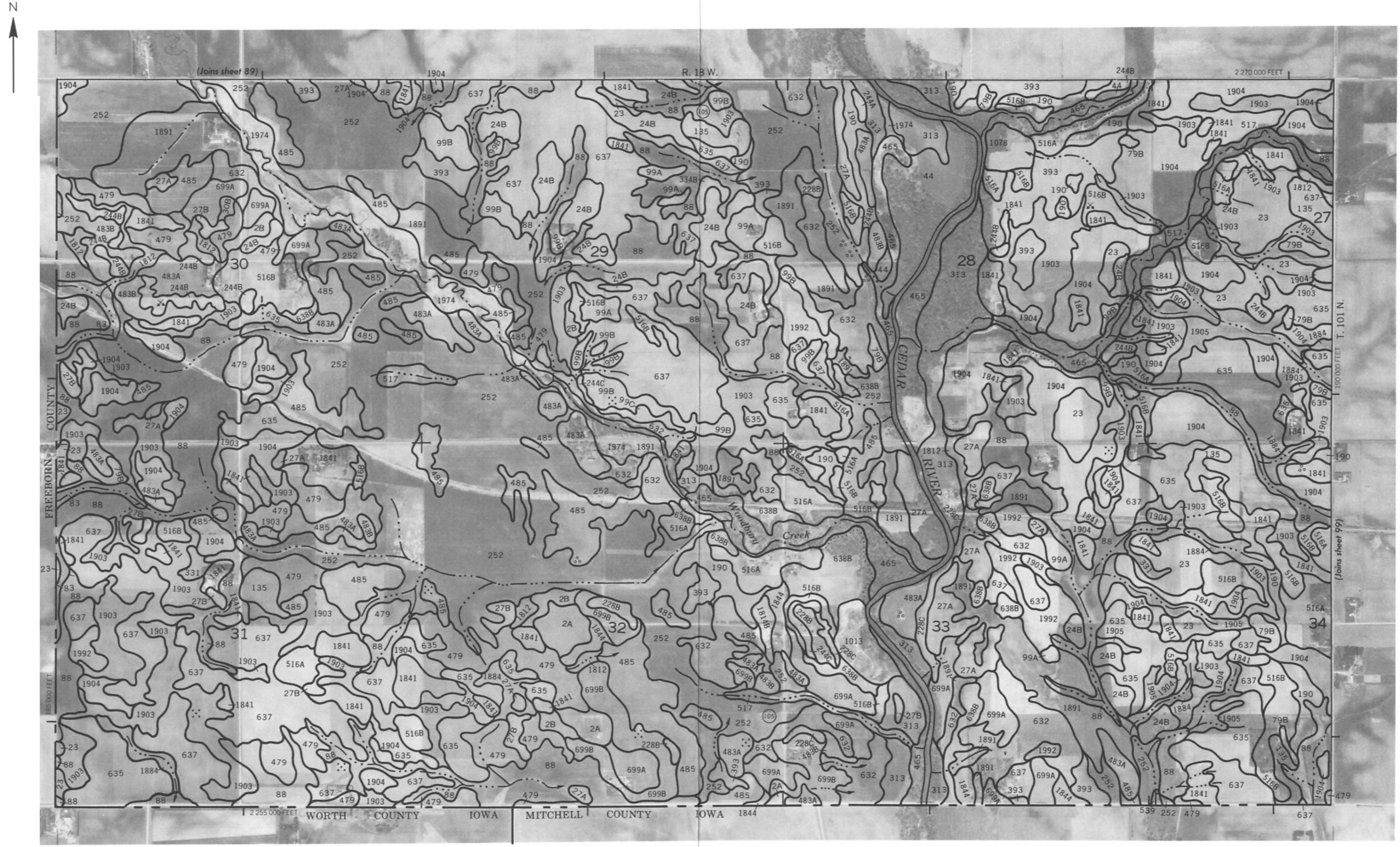
MOWER COUNTY, MINNESOTA — SHEET NUMBER 96


N
(Joins sheet 87)
R. 14 W.
2 400 000 FEET
(Joins sheet 95)
(Joins sheet 97)
T. 101 N.
205 000 FEET
200 000 FEET
2 385 000 FEET
(Joins sheet 105)
18
17
16
15
19
20
21
22
Iowa
River
Little
STATE PARK BOUNDARY
LAKE LOUISE
STATE PARK
Lake Louise
Up. Iowa

MOWER COUNTY, MINNESOTA — SHEET NUMBER 97

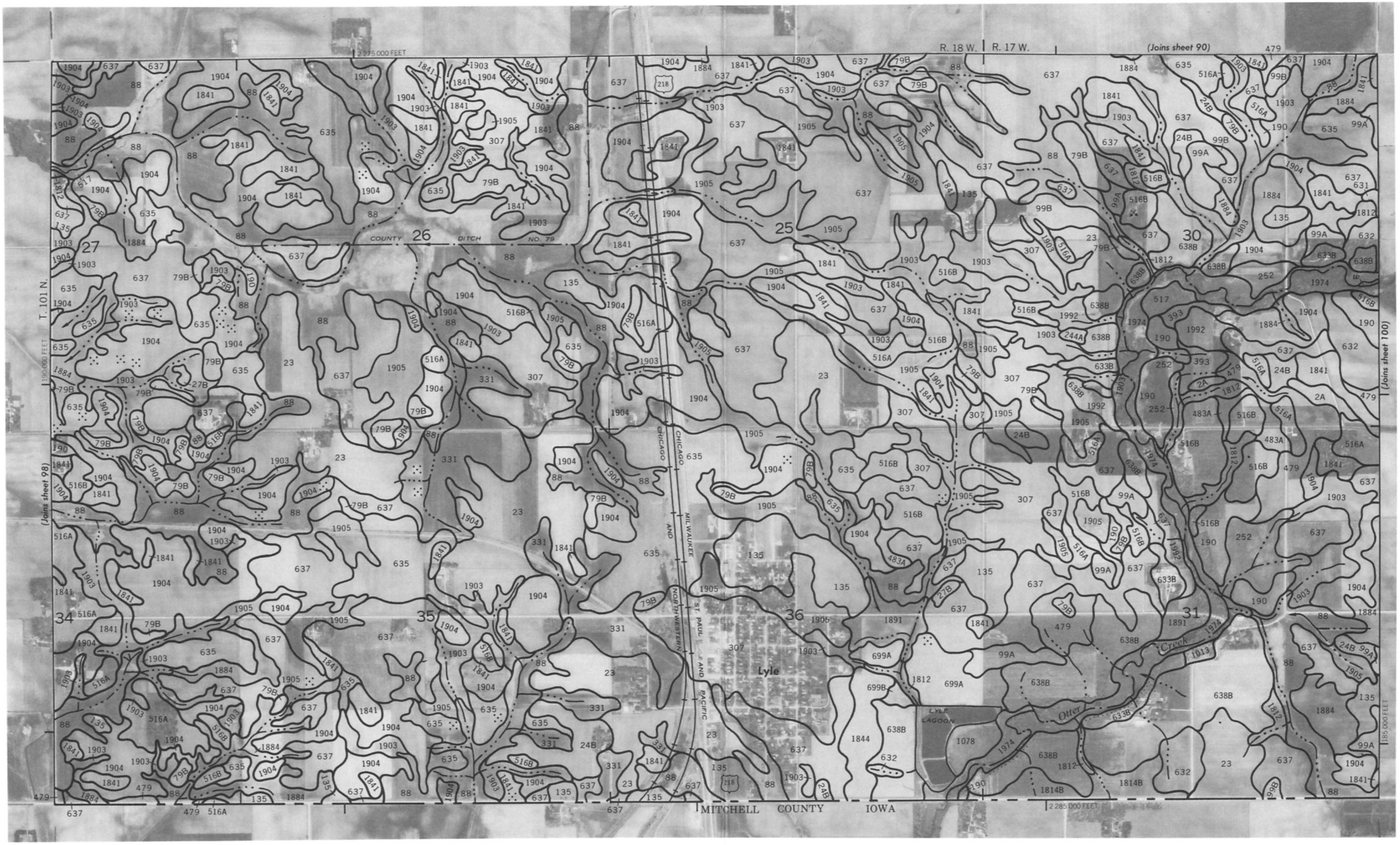

N
2 405 000 FEET
R. 14 W. (Joins sheet 88)
205 000 FEET
T. 101 N.
(Joins sheet 96)
FILLMORE COUNTY
14
13
23
24
(Joins sheet 106)
2 415 000 FEET
200 000 FEET
479
23
88
99B
1974

MOWER COUNTY, MINNESOTA — SHEET NUMBER 98

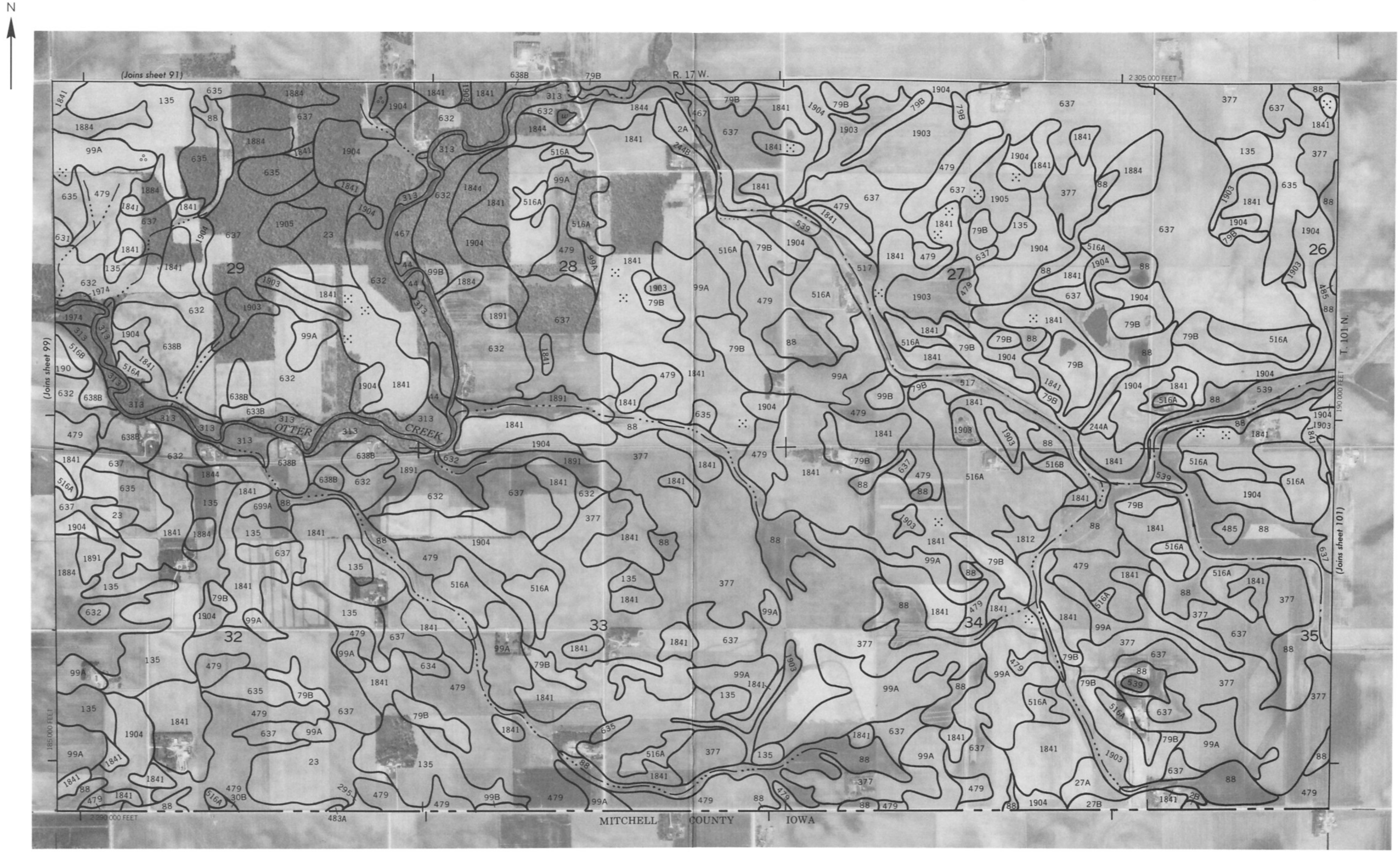

N
(Joins sheet 89)
R. 18 W.
2 270 000 FEET
T. 101 N.
190 000 FEET
(Joins sheet 99)
FREEBORN COUNTY
185 000 FEET
2 255 000 FEET
WORTH COUNTY IOWA
MITCHELL COUNTY IOWA
CEDAR RIVER
Woodbury Creek
27
28
29
30
31
32
33
34
105

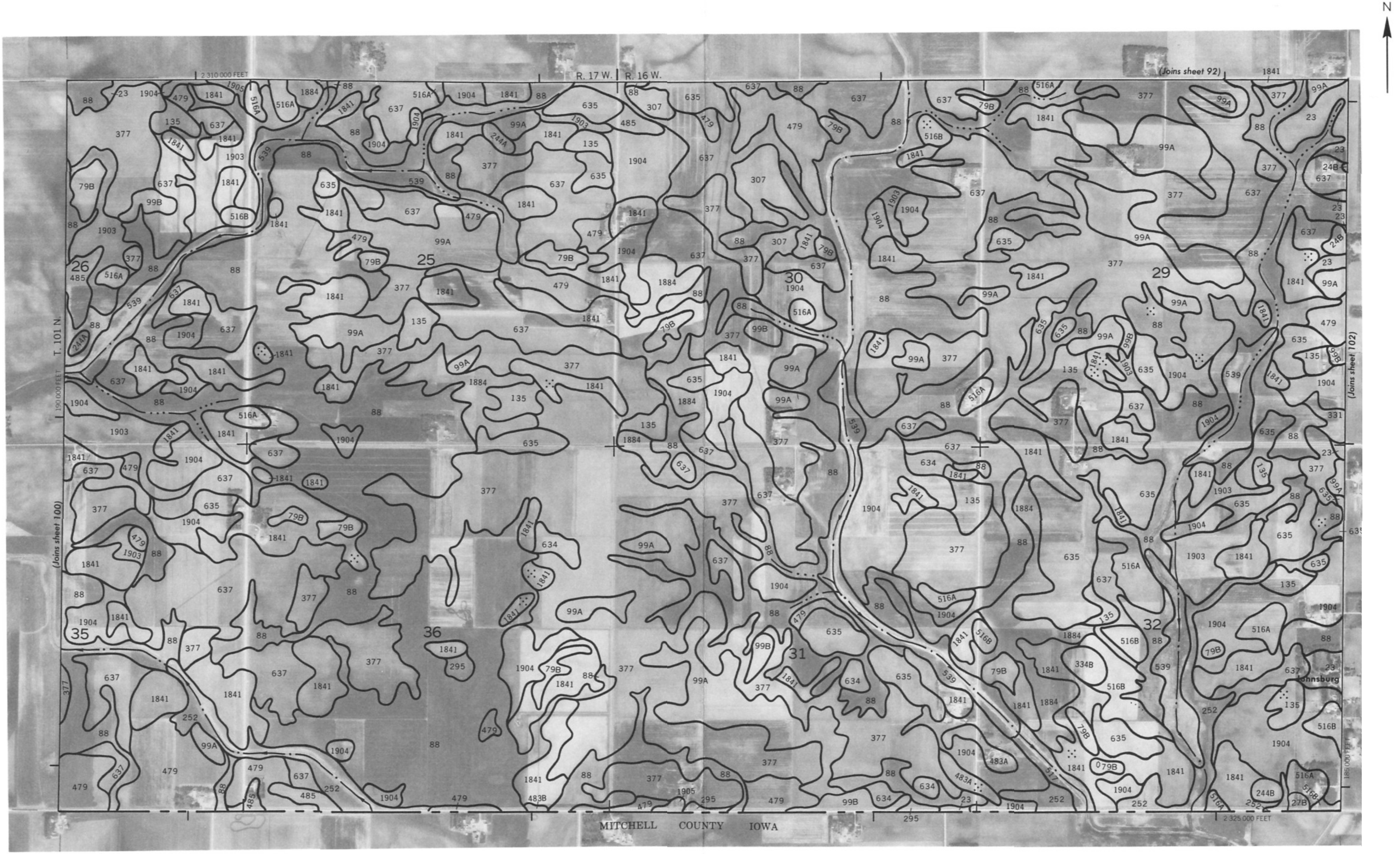
MOWER COUNTY, MINNESOTA — SHEET NUMBER 99

N

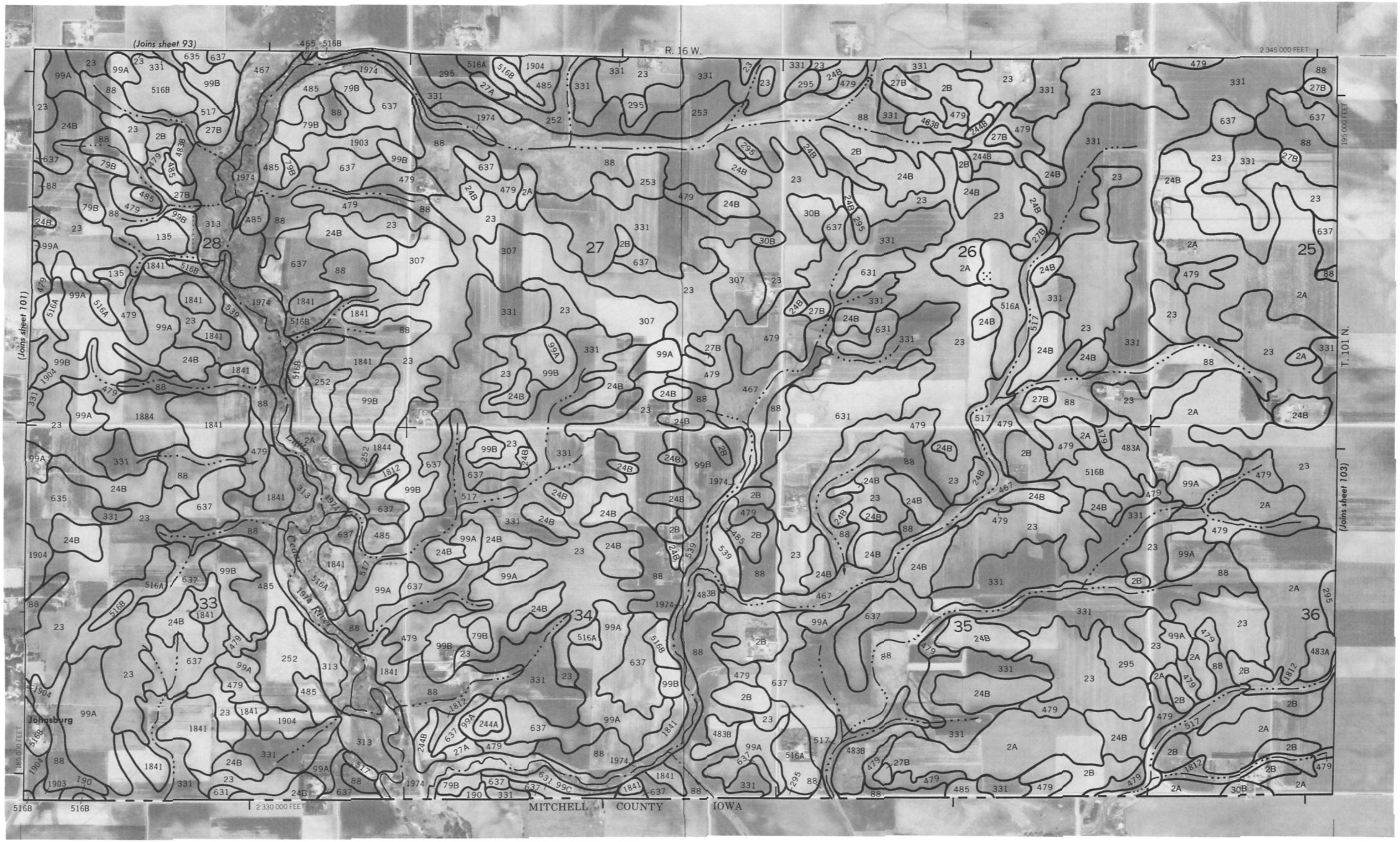

R. 18 W.
R. 17 W.
(Joins sheet 90)
(Joins sheet 100)
(Joins sheet 98)
T. 101 N.
2 275 000 FEET
2 285 000 FEET
190 000 FEET
185 000 FEET
COUNTY DITCH NO. 79
27
26
25
30
34
35
36
31
218
CHICAGO MILWAUKEE ST. PAUL AND PACIFIC
CHICAGO AND NORTH WESTERN
Lyle
LYLE LAGOON
Otter Creek
MITCHELL COUNTY IOWA

MOWER COUNTY, MINNESOTA — SHEET NUMBER 100

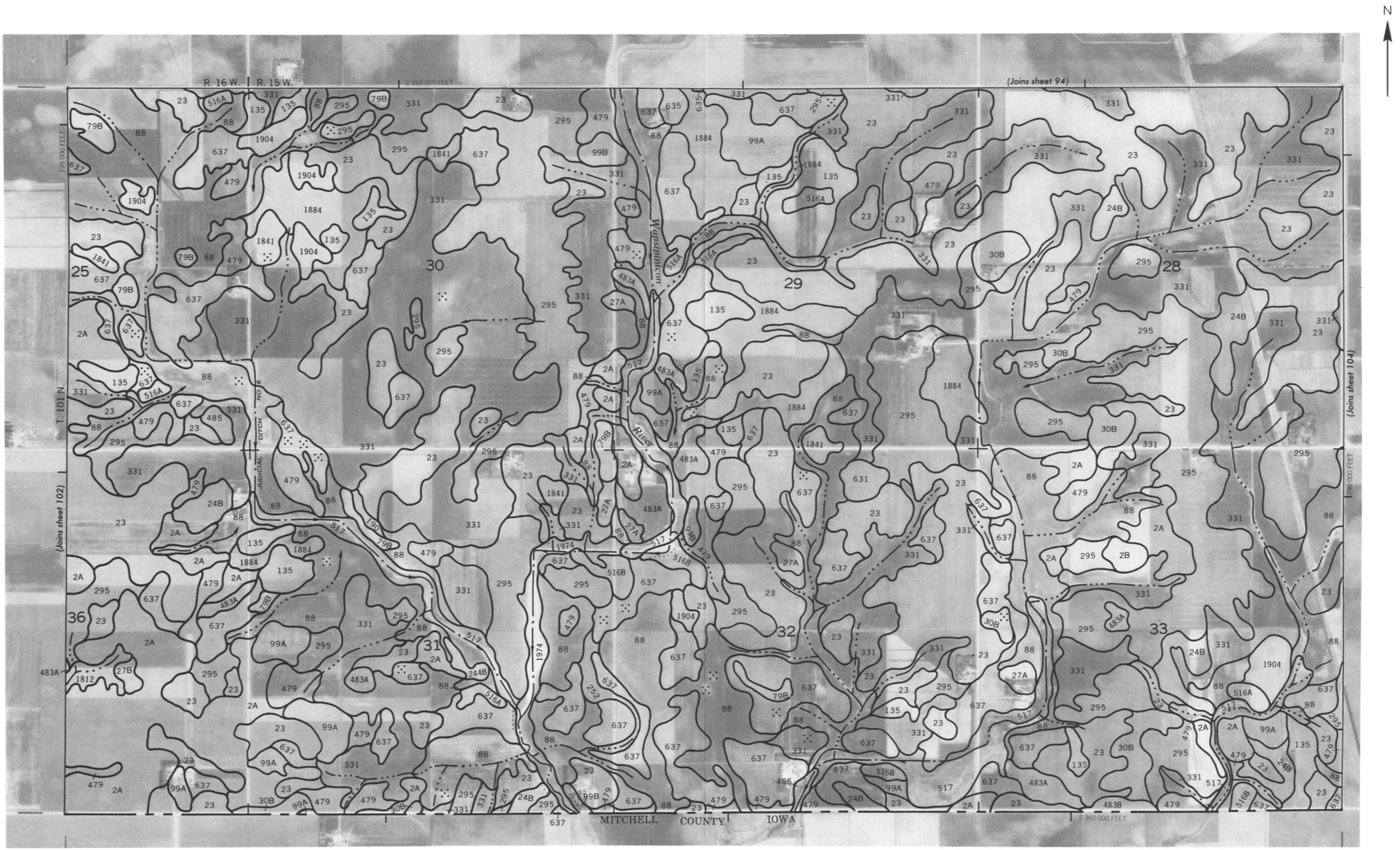

N
(Joins sheet 91)
R. 17 W.
2 305 000 FEET
(Joins sheet 99)
T. 101 N.
190 000 FEET
(Joins sheet 101)
185 000 FEET
2 290 000 FEET
OTTER
CREEK
26
27
28
29
32
33
34
35
MITCHELL
COUNTY
IOWA


N
2 310 000 FEET
R. 17 W.
R. 16 W.
(Joins sheet 92)
(Joins sheet 102)
(Joins sheet 100)
T. 101 N.
190 000 FEET
185 000 FEET
2 325 000 FEET
26
25
30
29
35
36
31
32
Johnsburg
MITCHELL COUNTY IOWA

N

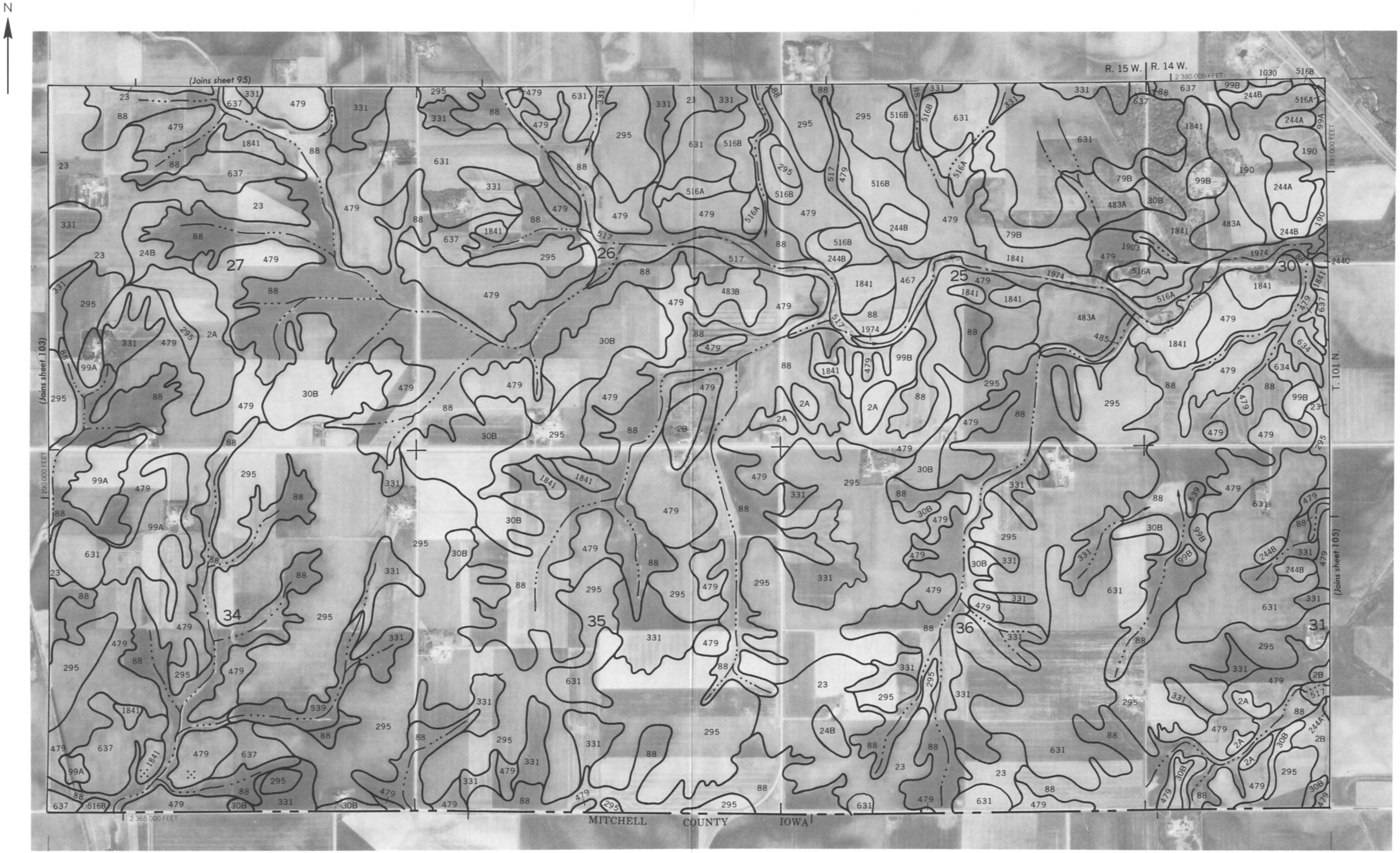

(Joins sheet 93)
R. 16 W.
2 345 000 FEET
195 000 FEET
T. 101 N.
(Joins sheet 101)
(Joins sheet 103)
188 000 FEET
2 330 000 FEET
28
27
26
25
33
34
35
36
Little Cedar River
Johnsburg
MITCHELL COUNTY IOWA

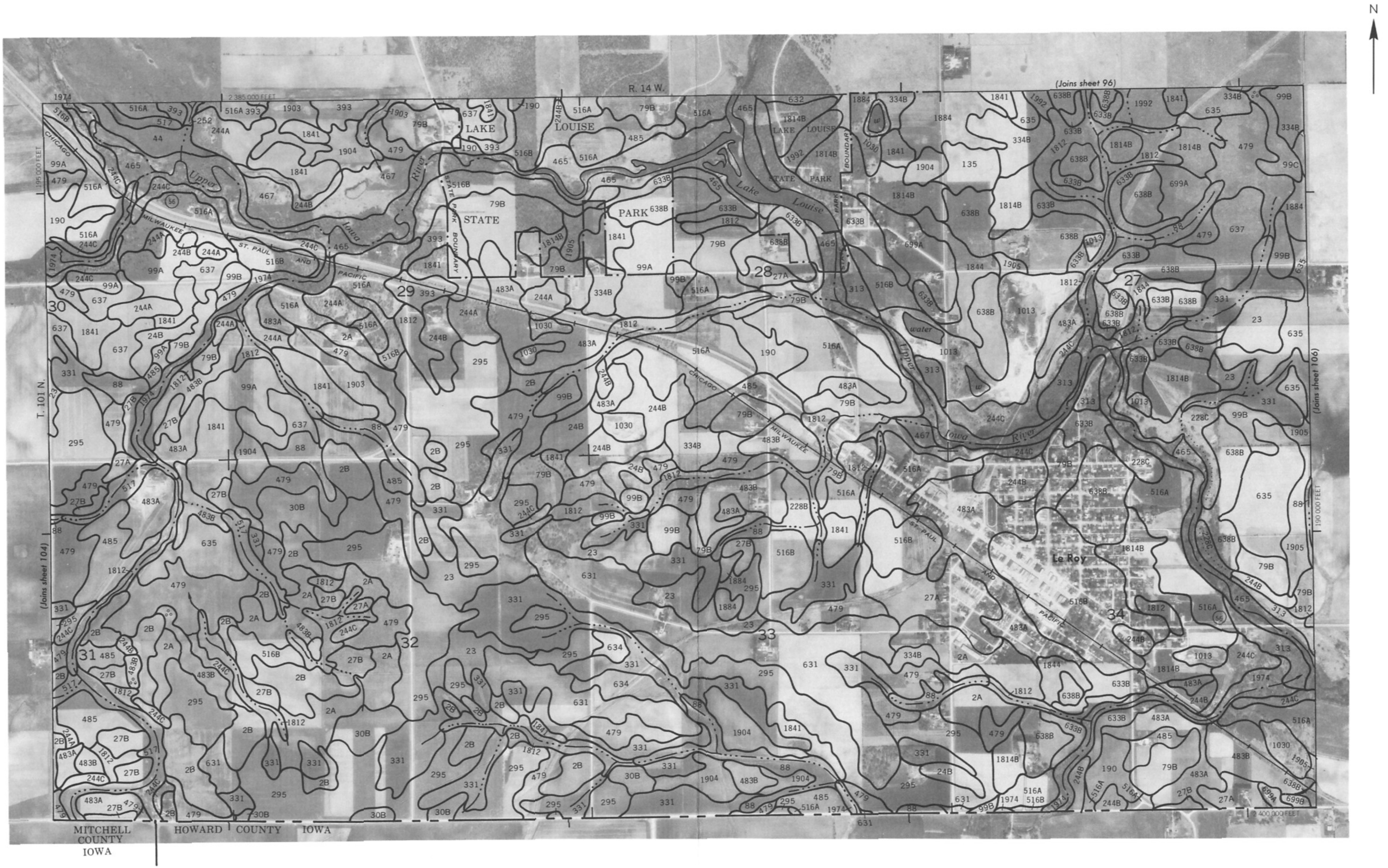
MOWER COUNTY, MINNESOTA — SHEET NUMBER 103


N
R. 16 W.
R. 15 W.
2 350 000 FEET
(Joins sheet 94)
195 000 FEET
T. 101 N.
(Joins sheet 102)
(Joins sheet 104)
190 000 FEET
2 360 000 FEET
25
30
29
28
36
31
32
33
JUDICIAL DITCH NO 6
Wapsipinicon River
MITCHELL COUNTY IOWA

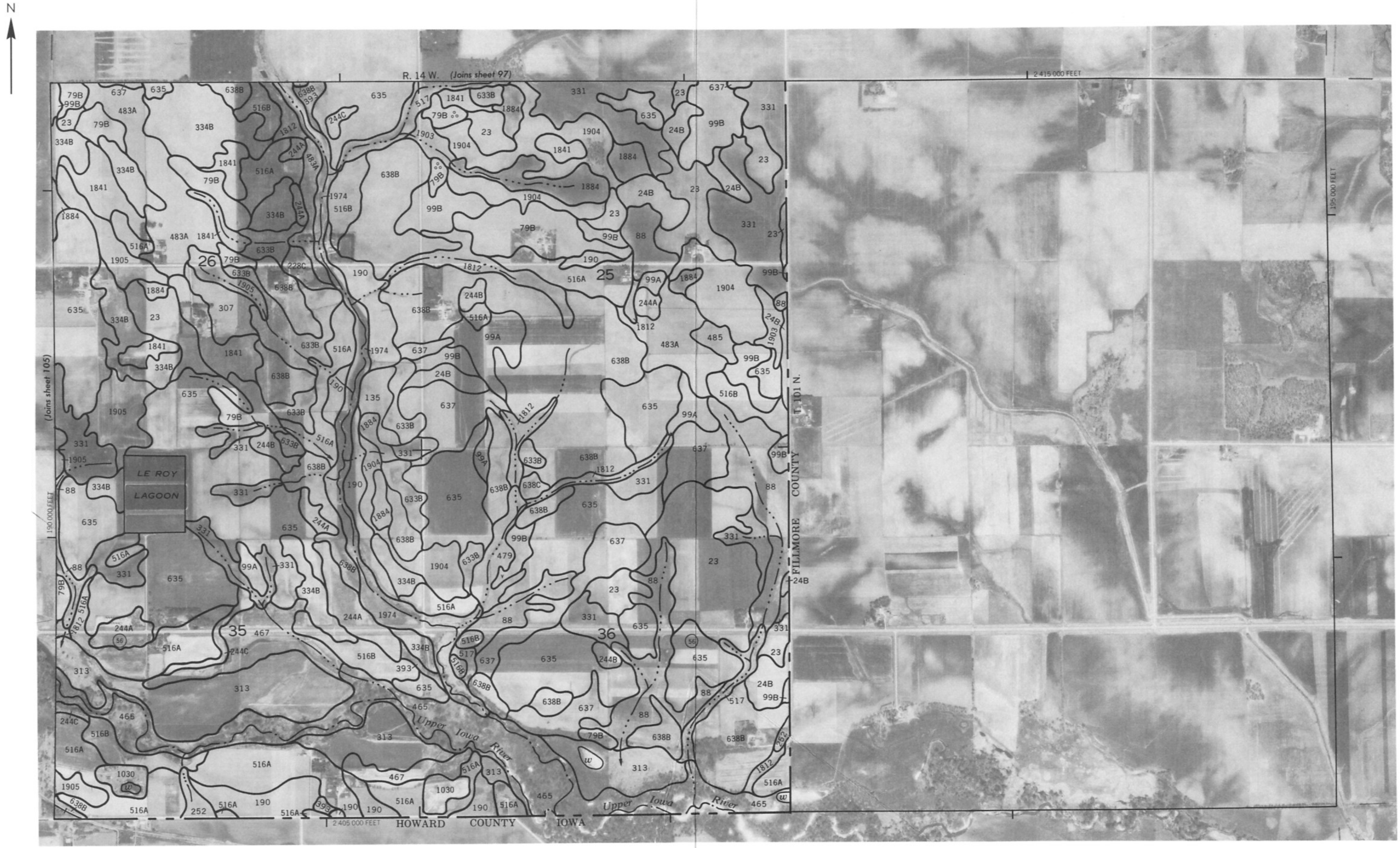
(104)

MOWER COUNTY, MINNESOTA — SHEET NUMBER 104


N
(Joins sheet 95)
R. 15 W.
R. 14 W.
2 380 000 FEET
195 000 FEET
T. 101 N.
(Joins sheet 103)
(Joins sheet 105)
190 000 FEET
2 365 000 FEET
27
26
25
30
34
35
36
31
MITCHELL
COUNTY
IOWA


N
R. 14 W.
2 385 000 FEET
(Joins sheet 96)
195 000 FEET
T. 101 N.
(Joins sheet 104)
(Joins sheet 106)
190 000 FEET
2 400 000 FEET
LAKE
LOUISE
STATE
PARK
STATE PARK BOUNDARY
Lake Louise
Upper Iowa River
Iowa River
CHICAGO MILWAUKEE ST. PAUL AND PACIFIC
water
Le Roy
56
27
28
29
30
31
32
33
34
MITCHELL
COUNTY
IOWA
HOWARD COUNTY IOWA

MOWER COUNTY, MINNESOTA — SHEET NUMBER 106


N
R. 14 W. (Joins sheet 97)
2 415 000 FEET
195 000 FEET
(Joins sheet 105)
190 000 FEET
T. 101 N.
FILLMORE COUNTY
2 405 000 FEET
HOWARD COUNTY IOWA
LE ROY LAGOON
Upper Iowa River
Upper Iowa River
25
26
35
36
56
56